



U.S. Army Corps  
of Engineers®  
Water Resources Support Center  
Institute for Water Resources

---

# ***Analysis of Nonresidential Content Value and Depth-Damage Data for Flood Damage Reduction Studies***



19970103 032



DISTRIBUTION STATEMENT A

Approved for public release;  
Distribution Unlimited

IWR Report 96-R-12  
May 1996



***ANALYSIS OF NONRESIDENTIAL CONTENT VALUE  
AND DEPTH-DAMAGE DATA FOR  
FLOOD DAMAGE REDUCTION STUDIES***

---

Prepared by:

Jack C. Kiefer  
J. Scott Willett

of:

Planning and Management Consultants, Ltd.  
6352 S. US Highway 51  
P.O. Box 1316  
Carbondale, IL 62903

for:

U.S. Army Corps of Engineers  
Institute for Water Resources  
Alexandria, VA 22315-3868

INFO QUALITY INSPECTED 2

May 1996

IWR Report 96-R-12

---

## **PREFACE**

This report was completed by Planning and Management Consultants, Ltd.(PMCL) under the Flood Mitigation, Formulation, Planning and Analysis research work unit at the Corps of Engineers (COE), Institute for Water Resources (IWR). Mr. Stuart Davis is the principal investigator for the research unit. The Flood Mitigation work unit is part of the Planning Methodologies research program, which is under the direction of Mr. Michael R. Krouse, Chief of Technical Analysis and Research Division at IWR.

The data used in this study were gathered by the Baltimore District of the Corps of Engineers. The authors would like to acknowledge Ms. Marianne N. Matheny of the Baltimore District for supplying much of the study background information. Special thanks are extended to Mr. Stuart Davis and Mr. David Hill of the Institute for Water Resources and Mr. Ron Connor, Headquarters, U.S. Army Corps of Engineers for their comments and review on earlier drafts of the report.

In addition, appreciation is extended to Dr. Jerzy Kocik of PMCL for his comments and suggestions during the development of the mathematical models. The authors would also like to thank Ms. Stephennie Brumley for the outstanding administrative support in preparing the final report. As always, any deficiencies in the report remain the responsibility of the authors.

# TABLE OF CONTENTS

LIST OF FIGURES .....	vii
LIST OF TABLES .....	ix
CHAPTER I. INTRODUCTION .....	1
BACKGROUND .....	1
OBJECTIVES .....	1
REPORT ORGANIZATION .....	2
CHAPTER II. THE WYOMING VALLEY SURVEY .....	3
BACKGROUND OF STUDY AREA .....	3
DEVELOPMENT OF SURVEY QUESTIONNAIRE .....	3
SAMPLE SELECTION AND SURVEY IMPLEMENTATION .....	4
DATA PREPARATION .....	5
BASIC DATA ANALYSES .....	8
Correlation Among Survey Variables .....	14
DAMAGE-TO-VALUE AND CONTENT-TO-STRUCTURE RATIOS .....	14
CHAPTER III. CONTENT VALUATION .....	17
NATURE OF CONTENT AND VALUE .....	17
MODEL DEVELOPMENT AND SELECTION .....	18
Simple Linear Specification .....	19
Mixed Log-Linear Specifications .....	20
Log-Log Specifications .....	22
FINAL MODEL SELECTION .....	22
SUMMARY .....	24
CHAPTER IV. SECONDARY SOURCES OF BUSINESS CONTENT DATA .....	27
INSURANCE INDUSTRY .....	27
Other Insurance Organizations .....	28
PUBLISHED GOVERNMENT SOURCES .....	28
Retail and Wholesale Industries .....	29
Manufacturing .....	29
COMMERCIAL DATA SOURCES .....	30
SUMMARY .....	31
CHAPTER V. DEPTH-DAMAGE FUNCTION ESTIMATION .....	33
STRUCTURE DEPTH-DAMAGE FUNCTIONS .....	33
Content Depth-Damage Functions .....	36
SUMMARY .....	37

## TABLE OF CONTENTS

---

CHAPTER VI. CONCLUSIONS AND RECOMMENDATIONS .....	41
SUMMARY AND CONCLUSIONS .....	41
RECOMMENDATIONS .....	42
REFERENCES .....	45
APPENDIX A      Wyoming Valley Survey Instrument .....	A-1
APPENDIX B      Basic Analyses .....	B-1
APPENDIX C      Analysis of Variance Output for Content Valuation Functions .....	C-1
APPENDIX D      Structure Depth-Damage Functions .....	D-1
APPENDIX E      Content Depth-Damage Functions .....	E-1

**LIST OF FIGURES**

II-1	Sample Mean Structure Damage-to-Value Ratios .....	15
II-2	Sample Mean Content Damage-to-Value Ratios .....	16
V-1	Piece-Wise Regression Procedure .....	34
V-2	General Model of Structure Depth-Damage Function .....	36
V-3	General Content Depth-Damage for Single-Story Buildings .....	38
V-4	General Content Depth-Damage for Multistory Buildings .....	38

**LIST OF TABLES**

II-1	Sample Size by Community .....	5
II-2	Example Application of Data Decision Rules to Hypothetical Flood Scenarios .....	7
II-3	Frequency of Responses to Binary Survey Variables .....	9
II-4	Frequency Distribution of Major Industries .....	10
II-5	Descriptive Statistics for Continuous Survey Variables .....	11
II-6	Content-to-Structure Ratio for Groups with Sample Size $\geq 20$ .....	16
III-1	Simple Linear Specification Parameter Estimates .....	20
III-2	Linear-Log Specification Parameter Estimates .....	21
III-3	Log-Linear Specification Parameter Estimates .....	21
III-4	Log-Log Specification Parameter Estimates .....	22
III-5	Alternative A .....	24
III-6	Alternative B .....	25
III-7	Alternative C .....	25

---

## CHAPTER I. INTRODUCTION



### BACKGROUND

Flood damages to nonresidential buildings and building contents constitute a major portion of the total damages from flooding. However, limited data are available for efficient and accurate assessment of flood damages for the many business activities that comprise the nonresidential sector. The wide assortment of business activities in the sector presents unique challenges in computing content values, content to structure ratios, and depth-damage functions. Each of these relationships are needed by the U.S. Army Corps of Engineers, both for estimating actual damages from flooding and for projecting hypothetical damages avoided as a result of flood control projects.

This study utilizes a database developed from a 1992 survey of businesses in the Wyoming Valley of Northeastern Pennsylvania. This region experienced record flooding in 1972, when Tropical Storm Agnes produced an extended period of rain sufficient to exceed the design capacities of the levees in the Wilkes-Barre area. During the flooding, many buildings were completely inundated. The survey was administered to over 600 businesses and elicited information on building characteristics, value of building contents, building structure value, previous flood damages, and expected damages for hypothetical flood levels.

### OBJECTIVES

Using the Wyoming Valley nonresidential survey, the current study has 4 principle objectives:

- (1) To determine content-to-structure ratios for business properties by Standard Industrial Classification (SIC)
- (2) To determine the most significant variables that influence variation in business content values, and to develop a mathematical model to aid in estimating business content values
- (3) To identify secondary sources of data that can aid in estimating nonresidential flood values and damages
- (4) To construct theoretical content and structure depth-damage functions for selected business activities

The results of this study are to be used by Corps districts in economic analyses of flood damage reduction projects. This study demonstrates how to estimate nonresidential flood damages

from generalized mathematical models using local data, and will alert districts of other possible data sources that may be used to quantify flood damages at relatively low cost.

## REPORT ORGANIZATION

Following this introductory chapter, Chapter II details the preparation and implementation of the Wyoming Valley Survey and the development of the survey database. The multi-step approach used to identify and verify potential outliers and the decision rules used to handle outliers and potential data conflicts are also presented. A descriptive statistical summary of selected variables and basic derived relationships from the validated database are also presented.

Chapter III presents a statistical approach for estimating nonresidential content values. Based on Wyoming Valley survey data, linear regression models are developed and estimated from variables hypothesized to be related to nonresidential content value. The chapter concludes with a presentation of the final statistical model that is recommended for content valuation.

Chapter IV reviews the availability and applicability of secondary sources for estimating nonresidential business content values. The results of telephone interviews with insurance industry sources are summarized, as are the results of archival research of published government documents and other commercially available sources of business content values.

Chapter V begins with a discussion of the underlying analyses that are necessary for estimating depth-damage functions for building contents and structures. A non-linear regression model is then presented for estimating percent structure and content damage over a continuous range of flood depths.

Chapter VI presents study conclusions and recommendations for further action.

Appendix A contains a copy of the actual Wyoming Valley survey questionnaire. Frequency distributions for content value are included in Appendix B for two and three-digit SIC groups. The alternative content valuation models are presented in Appendix C. Specific depth-damage functions for structure and building contents are identified and plotted for eight selected two-digit SIC groups that have relatively large sample sizes in Appendices D and E, respectively.

---

## CHAPTER II. THE WYOMING VALLEY SURVEY



This chapter details the development of the database used to estimate nonresidential business content values and associated depth-damage functions. The database utilizes data gathered in a 1992 flood damage survey conducted by the Baltimore District of the U.S. Army Corps of Engineers as part of the *Wyoming Valley Levee Raising Project*. Most of the businesses included in this survey were affected by the 1972 Tropical Storm Agnes flood event.

### BACKGROUND OF STUDY AREA

The Wyoming Valley lies in Luzerne County in northeast Pennsylvania approximately 110 miles northwest of New York City and 90 miles northeast of Harrisburg, Pennsylvania. The study area is formed by a system of levees protecting eight townships, all in Luzerne County which had a 1990 population of 328,149. An additional 406,026 live in the four surrounding counties. Approximately 115,000 people resided in the Wyoming Valley levee area in 1990. The area has made a transition from emphasis on the industrial and manufacturing sectors to the service sector. However, the nondurable manufacturing sector represents 13.5 percent of the area's employment in contrast to 7.2 percent nationally.

The valley has a long history of flooding. During the 100-year period between 1891-1991, the valley has been subjected to 56 floods that have exceeded channel bank capacity. The frequency of flooding resulted in construction of the levee system during the 1930's. Thus, since the 1940's, flooding in the area has been the result of levee overtopping. Historically, levee overtopping in the area has been associated with precipitation from hurricanes and tropical storms moving up the coast. Several shopping centers and high value industrial properties have located into the levee-protected floodplain areas resulting in high flood damage potential. An estimated 47,764 residents are employed by the businesses located in the levee-protected study area (Baltimore District, COE 1995).

### DEVELOPMENT OF SURVEY QUESTIONNAIRE

In order to obtain flood damage data for a proposed levee raising project, nonresidential flood damage information was gathered using a field survey. The survey sought to identify building characteristics having a potential impact on expected flood damages, such as building size in square feet, number of stories, and the existence of a basement. Other factors that affected the level of damages included damage mitigation measures used, amount of warning time, and the length of time the business was closed. Hypothetical flood damages were sought for both building structure and

contents at four discrete flood depths (1 foot, 4 feet, 8 feet, and 12 feet), based on a business experience during Tropical Storm Agnes. The major components of building content damage, equipment, inventory, business records, and vehicles, were estimated separately. These data were combined with variables identifying the standard industrial classification codes and standard land use codes for each respondent. Additionally, field personnel rated the building structure using the Marshall & Swift Commercial Estimator worksheet. The worksheet provides a format for presenting the building characteristics necessary to assess building structure value, including:

- Construction material
- Condition
- Type of heating and cooling
- Occupancy number (similar to SIC)

Each of the study variables were included on a written survey instrument (Appendix A). The instrument was administered to a sample of the nonresidential business in the Wyoming Valley to identify the potential benefits of raising the areas levees. Subsequently, the data have been used here-in to develop generalized estimates of content value and depth-damage relationships.

## **SAMPLE SELECTION AND SURVEY IMPLEMENTATION**

A preliminary inventory of Wyoming Valley businesses affected by Tropical Storm Agnes was conducted in 1979 to gather data to estimate expected annual damages (EAD). Individual business EADs were calculated using 1979 stage damage information and 1991 rating curve and discharge-frequency information. An examination of the flood damages revealed that the level of expected annual damage (EAD) for each nonresidential business would be the appropriate variable to consider for sample selection for the development of flood damage models. Analysis of EAD distributions revealed 93.8 percent (2,228 of 2,375) of the properties had EADs less than \$10,000, accounting for approximately 41 percent of total expected damages. The remaining 147 high value properties accounted for 59 percent of the area's total flood losses (Yoe 1991).

The analysis of EADs in the study area indicated a sharp damage level differential among the 2,375 establishments involved in 1979. A small group (147) of properties had high percentage of the potential flood damage, while a much larger group (2,228) of properties having significantly less individual contribution to total flood damages. In hopes of providing the best estimate of total potential flood damages, it was decided to survey all 147 high damage potential properties and use statistical sample design formulas to select an appropriately sized random sample of the remaining properties. The use of segregated sampling allows the investigator to set error bounds for each segment of the sample according to the weight each segment influences the population. A sample of the all high EAD properties insures a 100 percent confidence for the measuring the segment's population mean. It was decided that a random sample of 700 properties with relatively low

individual EADs combined with all 147 high EAD properties would provide a 95 percent confidence that the sample mean would be within 20 percent of the population mean.

During the field survey, interviewers were provided two lists of properties to be contacted and interviewed. The first list contained all 147 high EAD ( $> \$10,000$ ) properties. Due to the length of time between the 1972 flood event and the implementation of the survey, only 140 of the 147 high EAD properties were still in operation by the same businesses. The second list contained a randomized sample of the low EAD ( $< \$10,000$ ) properties. The total number of low EAD properties exceeded 700 due to sample size requirements for each community. Table II-1 presents a detailed breakdown of interview sample sizes by community located in the Wyoming Valley region (Baltimore District COE 1995).

**TABLE II-1**  
**SAMPLE SIZE BY COMMUNITY**

<b>Community</b>	<b>EAD &gt; \$10,000</b>	<b>EAD &lt; \$10,000</b>
Edwardsville	14	64
Exeter	0	84
Forty Fort	5	56
Hanover	3	59
Kingston	45	89
North Wilkes Barre	32	138
Plymouth	5	79
Swoyersville	2	66
South Wilkes Barre	34	83
<b>Total</b>	<b>140</b>	<b>718</b>

Source: Yoe 1991

## DATA PREPARATION

The original Wyoming Valley survey data was furnished by the Institute for Water Resources (IWR) in an EXCEL® spreadsheet format. The original survey dataset contained 606 records. Where possible, each business in the sample was assigned a standard industrial classification. Furthermore, corresponding data for depreciated structure replacement values were obtained from IWR and incorporated into the survey database. The addition of these two variable fields reduced

the dataset to 449 complete records. Standard data screening procedures were used to (1) verify null data fields, (2) correct obvious typographical errors, and (3) detect numeric codes for missing values. The database was then converted into a permanent SAS® dataset for analysis.

Once data entry for the main database was completed, several key variables were computed, including:

- (1) Content value (defined as the sum of three components: values for equipment and supplies left inside, inventory and raw material kept inside, and business records)
- (2) Content-to-structure value ratios (C/S ratios)
- (3) Damage to value ratios (i.e., percent damages) for 1, 4, 8, and 12 feet flood depths for contents, structure, and vehicles and other outside property variables

Aside from forming the principal variables to be used in the analysis, the creation of these variables served another critical role in uncovering inconsistencies in a number of survey responses. More specifically, some survey respondents reported property damages for specific flood depths in excess of reported total property value (i.e., damage/value ratios  $> 1.0$ ). In these instances, IWR was consulted in order to verify survey responses with the original survey forms. Although some mis-codings were found and corrected, there still remained a set of observations with inconsistent responses. In lieu of removing these observations from the database and sacrificing sample size, the following decision rules were implemented to retain the maximum number of observations possible:

For each of the content damage to content value, structure damage to structure value, and other outside property to other outside property value ratios and for each flood depth, the following actions were carried out:

Rule 1: If damage  $>$  value and  $1.0 < \text{damage/value} \leq 1.1$ , then damage = value

Rule 2: If  $1.1 < \text{damage/value} \leq 2.0$ , then value = max(damage)

Rule 3: If  $\text{damage/value} > 2.0$ , then damage is set to missing

Table II-2 provides examples of the application of these rules. In Case A, no corrective actions are required as damage-to-value ratios do not exceed 1.00. Case B illustrates an example of reported damages exceeding value by 10 percent or less. In this case, slight differences in survey responses are assumed to be the source of inconsistent values and Rule 1 is used to reset the damage estimate to the total value, effectively restricting the damage-to-value ratio to 1.00. Case C illustrates an instance where the total reported damage exceeds value by 10 to 100 percent. In this case, Rule 2 is applied to reset total value to the maximum reported damages reported for the 12 foot depth. The strike-outs indicate that percent damage has been recomputed based on the new (reset) content value (\$2,000). Case D illustrates the application of Rule 3. In cases where reported

**TABLE II-2**  
**EXAMPLE APPLICATION OF DATA DECISION RULES**  
**TO HYPOTHETICAL FLOOD SCENARIOS**

Case	Reported Content Value (\$)	1 Foot			4 Feet			8 Feet			12 Feet			Decision Rule Applied
		Reported Damage	Percent Damage	Adj. Pct. Damage	Reported Damage	Percent Damage	Adj. Pct. Damage	Reported Damage	Percent Damage	Adj. Pct. Damage	Reported Damage	Percent Damage	Adj. Pct. Damage	
A	1,000	100	10	10	500	50	50	750	75	75	1,000	100	100	none
B	1,000	500	50	50	1,100	110	100	1,100	110	100	1,100	110	100	1
C	1,000	500	50	na	1,000	100	na	1,500	100	na	2,000	200	na	2
	2,000			25			50			75			100	
D	1,000	2,500	250	•	3,000	300	•	2,800	280	•	5,000	500	•	3

damages exceeded total value by more than 100%, damage values were set to missing values for all flood levels for that observation.

The modifications to the dataset made using the three rules were maintained during further analyses. A total of 62 records were modified under Rule 1. Thirty-four records had value reset to equal maximum damage under Rule 2. Only 13 records were affected by Rule 3.

## BASIC DATA ANALYSES

Table II-3 describes the frequency distributions of responses to several binary, yes/no, survey questions. As shown, approximately 72 percent of the survey sample recalled being flooded in 1972 during the torrential rainfall produced by Tropical Storm Agnes. About one-third of respondents had taken actions to prevent damage during the 1972 flood. The most frequently mentioned precaution was raising items above flood waters, followed by moving items, and sandbagging. On average, these actions saved an estimated 6 percent in total damages. The flooding forced affected businesses to close for an average of 56 days.<sup>1</sup> Nearly 70 percent of respondents had flood insurance at the time of the survey. A sizable proportion of the sample had been planning major improvements or renovations in equipment, interior, and/or structure at the time of the survey, and had just completed major improvements within the 5 years prior to the survey. About one-half of the sample businesses reported having basements.

Standard Industrial Classification (SIC) codes, developed by the U.S. Census Bureau, provide a hierarchical structure for describing business types. Table II-4 reports the distribution of the sample among the 8 major SIC groups. According to this distribution, retail and service establishments are represented most frequently in the Wyoming Valley database.

Table B-1 of Appendix B reports the distribution of observations among 3-digit SIC groupings. Sample sizes at the 3-digit SIC level are typically very small. The largest 3-digit samples are denoted by SIC 581, eating and drinking places (n=37), and SIC 866, religious organizations (n=23). No other 3-digit classifications had more than 20 observations. Aggregating to the 2-digit SIC level resulted in eight groups of 20 or more observations. These two-digit groupings are:

- (1) SIC 54, Food Stores (n=32)
- (2) SIC 55, Automotive Dealers and Service Stations (n=35)
- (3) SIC 57, Furniture and Home Furnishing Stores (n=22)
- (4) SIC 58, Eating and Drinking Places (n=37)
- (5) SIC 59, Miscellaneous (n=37)
- (6) SIC 72, Personal Services (n=28)

---

<sup>1</sup>Analysis of the range and median values for number of days closed indicates that the mean value may be overly influenced by several businesses that closed for an extended period (refer to Table II-5).

TABLE II-3

## FREQUENCY OF RESPONSES TO BINARY SURVEY VARIABLES

Survey Question	Yes		No		N	Number Missing
	n	Percent	n	Percent		
<b>Flood Experience</b>						
Was your business flooded in 1972?	316	71.8	124	28.2	440	9
Does the business have flood insurance?	305	69.6	133	30.4	438	11
<b>Mitigation Efforts</b>						
Did business take any actions to prevent damage in 1972 flood?	108	33.3	216	66.7	324	125
Did your business try to prevent damage by raising items?	80	24.9	241	5.1	321	128
Did business try to prevent damage by sandbagging?	16	5.0	306	95.0	322	127
Did business try to prevent damage by moving items?	55	17.1	267	82.9	322	127
<b>Recent Capital Improvements</b>						
Any major improvements to expand operations in last 5 years?	229	51.9	215	48.4	444	5
Has business had major structure improvements in last 5 years?	180	40.5	264	59.5	444	5
Has business had major improvements in equipment in last 5 years?	156	35.4	285	64.6	441	8
Has business had major interior improvements in last 5 years?	164	36.9	281	63.1	445	4
<b>Planned Capital Improvements</b>						
Do you plan major improvements in furniture in next 5 years?	134	30.0	312	70.0	446	3
Do you plan major structure improvements during next 5 years?	89	20.1	354	79.9	443	6
Do you plan major equipment improvements during next 5 years?	63	14.3	377	85.7	440	9
Do you plan major interior improvement in next 5 years?	91	20.6	350	79.4	441	8
Is there a basement in the building?	197	48.3	211	51.7	408	41

**TABLE II-4**  
**FREQUENCY DISTRIBUTION OF MAJOR INDUSTRIES**

<b>Category</b>	<b>SICs</b>	<b>Number</b>	<b>Percent</b>
Construction	15-17	7	1.56
Manufacturing	20-39	36	8.02
Trans./comm./utility	40-49	13	2.90
Wholesale	50-51	19	4.23
Retail	52-59	190	42.32
Finance	60-67	26	5.79
Services	70-89	141	31.40
Public	91-97	9	2.00
Unclassified	-	8	1.78
<b>Total</b>		<b>449</b>	<b>100.00</b>

(7) SIC 75, Auto Repair, Services, and Garages (n=23)

(8) SIC 86, Membership Organizations (n=26)

Business classifications are analyzed in more detail in the development of depth-damage functions in Chapter V.

Table II-5 describes the distributions of survey variables that follow a continuous scale. The distributions are described using standard measures of central tendency. It should be noted that for some of the miscellaneous variables, certain misunderstandings and/or mis-codings of the survey questions were possible. For example, the responses for warning time required to remove all items in a particular establishment may include time units in hours or days. A similar situation occurs for elevation of the 1972 flood, which apparently was reported both in depth relative to the first floor and in mean sea level (MSL). In cases where a reported variable was obviously in error, it was reset to missing.

The mean floor area of buildings surveyed was 16,174 square feet. The median value for this variable, 5,000 square feet, suggests that the sample distribution of square footage is concentrated toward the smaller values. The typical sample establishment has one to two stories and has been in operation at the same location for approximately 28 years. The number of employees working at the sample facilities ranges from 1 to 530 people. The mean number of employees per business sampled is 24, while the median is 6 employees.

The sample distributions of nearly all of the variables related to replacement costs and damages are characterized by wide dispersion, as demonstrated by standard deviations of replacement costs ranging from \$255,685 to \$2.71 million (in 1992 dollars). Replacement costs for

TABLE II-5

## DESCRIPTIVE STATISTICS FOR CONTINUOUS SURVEY VARIABLES

Variable	Survey Question	Minimum	Maximum	Mean	Median	Standard Deviation	Sample Size
<b>Miscellaneous</b>							
Number of buildings <sup>1</sup>		1	6	1.17	1.00	0.55	445
Number of employees= full-time + part-time		1	530	23.94	6.00	61.23	424
Depth of flood relative to 1st floor		-3	40	9.12	8.00	5.62	351
Days closed due to flood		0	365	56.31	21.00	71.67	277
Percent of potential damage prevented		0	100	0.06	0.00	0.17	320
Warning time to remove all items		0	888	51.77	2.00	99.13	429
Elevation of the 1972 flood		0.5	24.0	11.23	10.00	5.26	71
Total floor area in square feet <sup>1</sup>		192	333,000	16,174.08	5,000.00	3,109.89	446
Number of stories <sup>1</sup>		1	11	1.70	1.00	1.02	442
Elevation at the first floor of this building <sup>1</sup>		439.6	590.2	543.22	542.50	18.56	436
Zero damage elevation <sup>1</sup>		439.2	588.8	542.28	541.00	8.35	435
Years at location		0	202	28.14	19.00	28.81	425
<b>Reported Replacement Costs<sup>1</sup></b>							
Replacement value of structural elements		2,000	33,000,000	1,022,232	25,000	2,708,279	398
Replacement value of equipment and supplies		500	21,000,000	402,662	70,000	1,620,345	443
Replacement value of inventory and raw materials		100	86,000,000	613,995	45,000.	4,655,717	376
Replacement value of business records		50	5,000,000	119,117	10,000	488,839	307
Replacement value of vehicles kept at building		200	5,500,000	147,128	25,000	470,208	228
Replacement value of equipment/supplies/inventory		100	2,000,000	88,590	20,000	255,686	115
Replacement value of landscape/parking areas		100	9,000,000	85,187	1,500	573,788	306
<b>Structural damages</b>							
Structural damage with 1 foot of flooding		0	10,000,000	174,161	20,000	635,642	382
Structural damage with 4 feet of flooding		0	10,000,000	268,435	60,000	784,612	381
Structural damage with 8 feet of flooding		0	10,000,000	385,825	100,000	916,303	379
Structural damage with 12 feet of flooding		30	10,000,000	432,235	150,000	1,005,408	377

TABLE II-5 (Continued)

## DESCRIPTIVE STATISTICS FOR CONTINUOUS SURVEY VARIABLES

Variable	Survey Question	Minimum	Maximum	Mean	Median	Standard Deviation	Sample Size
<b>Content damages</b>							
Content damage with 1 foot of flooding		0	15,000,000	305,039	25,000	1,433,020	385
Content damage with 4 feet of flooding		0	19,000,000	454,398	61,000	1,672,959	385
Content damage with 8 feet of flooding		125	19,000,000	543,073	95,000	1,780,213	381
Content damage with 12 feet of flooding		125	19,000,000	578,771	100,000	1,823,062	376
<b>Vehicle and outside property (VOP) damages</b>							
Vehicle and outside property damage with 1 ft flooding		0	2,000,000	16,146	0	111,611	370
Vehicle and outside property damage with 4 ft flooding		0	2,150,000	68,145	5,000	234,810	369
Vehicle and outside property damage with 8 ft flooding		0	3,000,000	82,316	8,750	279,734	366
Vehicle and outside property damage with 12 ft flooding		0	3,000,000	82,961	9,500	282,925	366
<b>Clean-up costs</b>							
Emergency and cleanup costs with 1 ft flooding		0	1,000,000	53,686	10,000	153,258	434
Emergency and cleanup costs with 4 ft flooding		0	2,000,000	75,726	15,000	216,022	434
Emergency and cleanup costs with 8 ft flooding		0	3,000,000	94,040	20,000	275,419	434
Emergency and cleanup costs with 12 ft flooding		0	4,000,000	110,369	20,000	338,744	432
<b>Reported Damages for 1972 Flood Level</b>							
Structural damage		0	10,000,000	359,057	75,000	925,998	342
Content damage		0	15,000,000	430,899	70,000	1,453,960	368
Vehicle and outside property damage		0	3,000,000	92,311	6,000	332,222	356
Emergency and cleanup costs		0	1,500,000	75,716	20,000	178,106	357
<b>Aggregate values</b>							
Contents (equipment, inventory, and business records)		1,600	86,605,000	1,055,991	165,000	4,980,692	397
Vehicles, external equipment, and landscape		0	5,510,000	148,803	27,750	465,134	384
Depreciated structure replacement value		10,897	22,557,940	685,203	184,315	1,911,670	449
Structure value, vehicles, outside property, and contents		21,500	55,520,000	2,016,036	572,500	4,912,873	318
Replacement value, vehicles, outside property, and contents		28,741	45,077,940	1,659,365	452,205	4,157,993	356

TABLE II-5 (Continued)

## DESCRIPTIVE STATISTICS FOR CONTINUOUS SURVEY VARIABLES

Variable	Survey Question	Minimum	Maximum	Mean	Median	Standard Deviation	Sample Size
<b>Damage to Value Ratios</b>							
Content to structure ratio <sup>2</sup>		0.02	351.45	2.66	0.85	18.09	397
Content to structure ratio (without business records.) <sup>2</sup>		0.02	350.03	2.45	0.73	18.00	397
<b>Building Contents</b>							
Content damage/content value with 1 ft of flooding.		0	1.0	0.27	0.19	0.26	385
Content damage/content value with 4 ft of flooding		0	1.0	0.53	0.50	0.31	385
Content damage/content value with 8 ft of flooding		0	1.0	0.67	0.76	0.30	381
Content damage/content value with 12 ft of flooding		0	1.0	0.71	0.83	0.30	376
<b>Structure</b>							
Structure damage/structure value with 1 ft of flooding		0	1.0	0.16	0.10	0.19	382
Structure damage/structure value with 4 ft of flooding		0	1.0	0.30	0.20	0.27	381
Structure damage/structure value with 8 ft of flooding		0	1.0	0.46	0.40	0.33	379
Structure damage/structure value with 12 ft of flooding		0	1.0	0.58	0.56	0.36	377
<b>Vehicles &amp; Outside Property (VOP)</b>							
VOP damage/VOP value with 1 ft flooding		0	1.0	0.11	0.00	0.26	320
VOP damage/VOP value with 4 ft flooding		0	1.0	0.45	0.40	0.41	318
VOP damage/VOP value with 8 ft flooding		0	1.0	0.51	0.51	0.42	316
VOP damage/VOP value with 12 ft flooding		0	1.0	0.51	0.54	0.42	316
<b>Total Damage</b>							
Total damage with 1 ft of flooding		0	16,000,000	4,627,796	64,500	1,775,434	288
Total damage with 4 ft of flooding		5,000	17,750,000	711,896	182,500	1,958,006	288
Total damage with 8 ft of flooding		4,500	17,100,000	816,875	262,000	1,881,800	281
Total damage with 12 ft of flooding		8,000	18,000,000	888,194	302,750	1,889,452	276
Total damage to total value ratio with 1 ft <sup>2</sup>		0	0.86	0.18	0.13	0.17	288
Total damage to total value ratio with 4 ft <sup>2</sup>		0	1.0	0.39	0.36	0.23	288
Total damage to total value ratio with 8 ft <sup>2</sup>		0.01	1.0	0.52	0.52	0.25	281
Total damage to total value ratio with 12 ft <sup>2</sup>		0.01	1.0	0.60	0.62	0.27	276

<sup>1</sup> Reported values of zero were recorded as missing. <sup>2</sup> Depreciated structure value is used in the denominator of these ratios.

each damage component ranged from typical values in the hundreds of thousands of dollars to maximum values in the tens of millions of dollars. Damage values were generally an order of magnitude less, but still maintained very large standard deviations. The derived aggregate measures of content value, vehicle and other outside property value, and total property value show substantial variation, as well.

### **Correlation Among Survey Variables**

Table B-2 of Appendix B presents a correlation matrix which describes the magnitude and statistical significance of bivariate relationships among selected Wyoming Valley survey variables. As expected, many significant correlations exist in the data. The size of a building in square feet and total value of building contents were positively correlated with the number of employees, number of stories, depreciated replacement value, value of inventory, business records, equipment value and vehicles on site. Businesses with larger buildings also tended to have been at that location for a longer period of time. As will be shown in Chapter III, the variables with significant correlations can be used as predictors of total building content values.

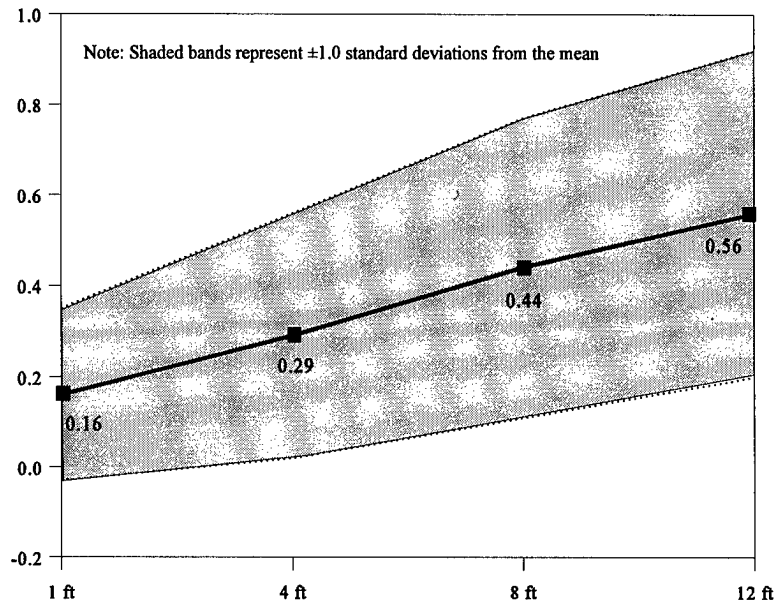
### **DAMAGE-TO-VALUE AND CONTENT-TO-STRUCTURE RATIOS**

The last section of Table II-5 describes the sample distributions of damage-to-value and content-to-structure ratios. The damage-to-value ratios are reported for each property item and for each flood depth scenario described in the survey. As might be expected, mean damage-to-value ratios rise relatively sharply over the 1 to 4 foot flood depth interval, and then taper off. The maxima of these ratios are all 1.0, which is a result of implementing the decision rules described earlier in this chapter. Figures II-1 and II-2 provide a plot of damage-to-value ratios across flood depths for structure and contents, respectively. The bands on each figure represent  $\pm 1$  standard deviation from the mean damage to value ratios for each specific flood depth, and noticeably provide a wide range of potential values. The width of the bands due primarily to widely varying values for structures, contents, reported damages among and within SIC groups. A statistical treatment of these depth-damage relationships is presented in Chapter V.

Table II-5 reports the sample mean content-to-structure ratio<sup>2</sup> to be 2.66, with a sample median of 0.84. This implies that the sample distribution of C/S ratios is skewed to the right. Omitting business records from content value is shown to lower both the sample mean and median C/S ratios to 2.44 and 0.73, respectively. The large variation in the C/S ratio is indicative of the large degree of heterogeneity in the business sector.

---

<sup>2</sup> Recall, that the content-to-structure ratio is defined here as content value divided by depreciated structure replacement value.



**Figure II-1. Sample Mean Structure Damage-to-Value Ratios**

Table B-3 of Appendix B provides a reference table of C/S ratios (with and without incorporation of business records) for each 3-digit SIC classification represented in the data. However, because of the very small sample sizes, readers are cautioned with regard to generalizing these results. Table B-4 of Appendix B summarizes the portions of content value that accrue to interior equipment, business records, and inventory. Again, due to small sample sizes, readers are not encouraged to make statistical inferences.

Table II-6 reports C/S ratios for seven 2-digit SIC classes that have sample sizes of at least 20 observations.<sup>3</sup> Because of the somewhat larger sample sizes, the findings for these groups may be considered slightly more applicable outside of the current sample. It must be kept in mind, however, that the distributions of C/S ratios within these groups still show considerable dispersion around their respective means.<sup>4</sup>

The remainder of the report uses the Wyoming Valley database to establish building content valuation formulas and estimate depth-damage relationships for structures and building contents.

<sup>3</sup> SIC 86, Membership Organizations, a group of 26 businesses, had only 18 observations for the C/S ratios.

<sup>4</sup> According to the Central Limit Theorem, the precision of estimates based on a sample depends on the size of the sample rather than the population size. The standard error resulting from sampling is proportional to the square root of the sample size. It is standard practice to consider a sample size of 30 as sufficient to provide a basis for meaningful statistical inferences. However, the Wyoming Valley data contains only three 2-digit SIC categories with sample sizes of 30 or greater-- hence, the reason for focusing on groups with relatively larger sample sizes of 20 or greater. Restriction to a sample size of 20 increases the uncertainty around the estimates of C/S ratios. Numeric assessment of the true degree of uncertainty is difficult since it depends on the distribution of the population.

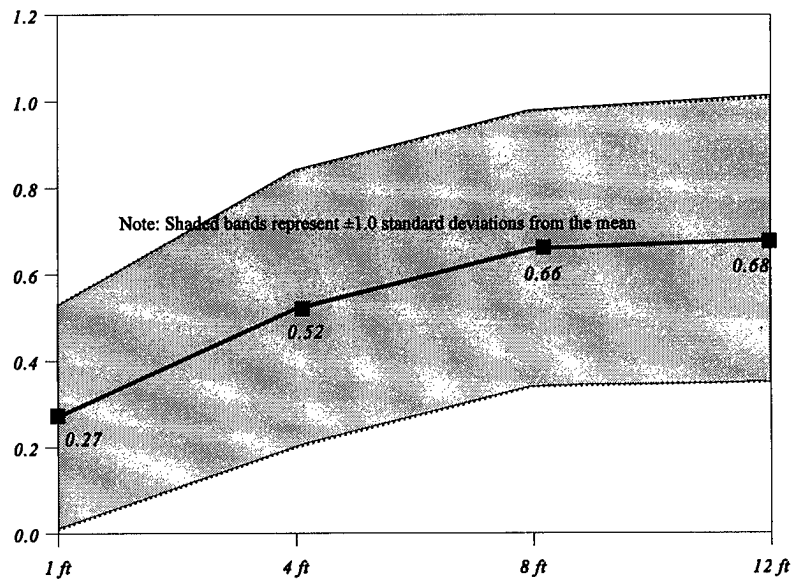


Figure II-2. Sample Mean Content Damage-to-Value Ratios

**TABLE II-6**  
**CONTENT-TO-STRUCTURE RATIO**  
**FOR GROUPS WITH SAMPLE SIZE  $\geq 20$**

2-Digit SIC	Description	Sample Size	Content-to-Structure Ratio <u>with</u> Business Records		Content-to-Structure Ratio <u>without</u> Business Records	
			Mean	Std. Dev.	Mean	Std. Dev.
54	Food store	27	1.90	1.93	1.69	1.72
55	Auto dealers and service stations	32	1.36	1.93	1.22	1.92
57	Furniture and home furnishing stores	21	2.03	3.92	1.80	3.74
58	Eating and drinking places	34	0.50	0.33	0.49	0.32
59	Miscellaneous retail	34	1.67	1.81	1.45	1.67
72	Personal service	27	1.70	2.44	1.62	2.44
75	Auto repair, services, and garages	20	1.23	1.06	1.15	1.00

---

## CHAPTER III. CONTENT VALUATION



This chapter presents a mathematical model that can be used to predict nonresidential business content value. The model is constructed using regression analysis and data from the Wyoming Valley nonresidential survey. Content value is defined as the sum of values of (1) equipment and supplies kept inside, (2) inventory and raw material kept inside, and (3) business records.

### NATURE OF BUILDING CONTENT AND VALUE

Variation in nonresidential content value stems predominantly from variation in the types of business activity that is performed. For example, an auto repair shop may be expected to have fewer and lower dollar-valued contents than a bank, which may house millions of dollars in business records. It is important to note, however, that the business sector is very heterogenous even within a specific type of business activity. In other words, two or more businesses providing the same service may have very different contents. Referring to the previous example, one auto repair shop may contain expensive computerized engine monitoring devices, while another may be equipped with more traditional instruments. Similarly, banks should be expected to vary widely with regard to the number of customers served and with the value of contents on site. The discriminative character of nonresidential businesses makes it difficult to establish generic mathematical models of content value.

The Wyoming Valley survey provided several variables that can be used to indicate differences (i.e., explain variation) in reported content values among the sample. The correlation matrix presented in Table B-2 of Appendix B was examined to identify simple bivariate relationships to be considered. Generally, the variables identify building characteristics, type and size of business activity, and previous flood experiences. The following set of variables were hypothesized to be related to content value and were retained for the regression analysis:

- Square footage of building
- Number of employees
- Depreciated structure replacement value
- Number of years at location
- Past flood experience (0 = not flooded, 1 = flooded by Agnes)
- Number of buildings at location
- Standard Industrial Classification (SIC)
- Indicator for basement (0 = no basement, 1 = basement)
- Number of stories
- Indicator for flood insurance (0 = no flood insurance, 1 = flood insurance)

Areal extent of the building in square feet and the number of employees are expected to have a positive correlation with total building content value. It is reasonable to assume that larger buildings contain more equipment and inventory (either raw materials or finished products). In the same vein, a greater number of employees likely implies a greater amount of capital equipment. In addition, depreciated structure value is expected to be positively correlated to building contents through its relation to building size. The variables denoting the existence of a basement, additional stories, and number of buildings are already captured in total building area, but are included separately as characteristics of the structure and business.

Previous flood experience is hypothesized to be negatively correlated with total content value. Previous floodplain behavior studies suggest that businesses that have been flooded before might be expected to relocate high value contents away from the floodplain (Sims and Baumann 1983; Slovic et al. 1974). Similarly, businesses that have purchased flood insurance have recognized the potential risk, just as those with previous flood experiences, and would be expected to attempt to reduce potential losses by avoiding high value investment in the floodplain (Sorkin 1982; Slovic et al. 1974; Willett 1995).

Individual Standard Industrial Classifications (SICs) are expected to have significant relationships with content value and are expected to provide valuable insight into total building content value. However, there is no direct expected statistical relationship. Instead, individual SIC groups should be interpreted relative to one another. These variables are included as categorical (dummy) variables in the modeling process.

Finally, one might expect a positive correlation between years at location and building contents within individual SIC groups as capital is accumulated over time. However, it may be difficult to detect this effect, given the heterogeneous nature of the businesses found in the Wyoming Valley study area.

## **MODEL DEVELOPMENT AND SELECTION<sup>5</sup>**

Development of a well fitting statistical model for estimating building content value is dependent on three major criteria:

- Quality of input data
- Selection of an appropriate set of variables
- Specification and form of model

---

<sup>5</sup> Appendix C provides analysis of variance summaries for each of the models presented in this section.

In order to assess the performance and fit of alternative statistical models, four criteria were applied to each alternative:

- Alignment of parameter signs with theoretical expectation
- Tests of significance of individual parameters (*t*-values)
- Test of overall model significance (*F*-value)
- Test of the explanatory power of the model (adjusted  $R^2$ ).

Standard statistical benchmarks recommend *t*- and *F*-values to be significant at the 5 percent confidence level. This translates to absolute *t*- and *F*-values of 1.96 and 1.67, respectively. Additionally, the model specification with the highest explanatory power (adjusted  $R^2$ ) is desired. However, utilizing these strict statistical standards without adequate theoretical underpinnings is undesirable (Kennedy, 1986). Thus, the preferred model may have several individual parameter estimates with relatively insignificant *t*-values and may well not have the highest  $R^2$ .

The following sections analyze alternative content value model formulations, with emphasis on functional form. First, alternative functional forms are tested using a basic set of study variables including building square footage, number of employees, past flood experience, and years at location. Then, using an expanded set of variables, recommendations are made with regard to final model selection based on the statistical principles outlined above.

### Simple Linear Specification

Within the framework of simple linear regression, a basic set of variables (size of building, number of employees, past flood experience, and years at that location) was analyzed (Equation 3.1). Examination of the linear model indicated that building square footage and number of employees were significant indicators of content value (Table III-1). The previous flood experience variable failed to meet theoretical expectations for appropriate sign and was statistically insignificant. Years at location retained a negative coefficient and was also statistically insignificant. Additionally, the overall explanatory power of the model was less than desired, with an adjusted *R*-square value of 0.0641. Consequently, this specification was rejected.

#### Simple Linear Specification

$$\text{Content Value} = \beta_0 + \beta_1 SF + \beta_2 EMP + \beta_3 YEARS + \beta_4 FLOOD \quad (3.1)$$

**TABLE III-1**  
**SIMPLE LINEAR SPECIFICATION PARAMETER ESTIMATES**

<b>Variable</b>	<b>Parameter Estimate (<math>\beta_i</math>)</b>	<b>T for H0: Parameter = 0</b>
Intercept	128896	0.244
Building Square Footage (SF)	30.8482	3.539
Number of Employees (EMP)	10939	2.557
Years at Location (YEARS)	-11012	-1.067
Flooded during Agnes (FLOOD)	691381	1.103
Dependent variable: Content Value	Adjusted R <sup>2</sup> : 0.0641	F Value: 6.920

### Mixed Log-Linear Specifications

Natural logarithmic transformations of selected continuous variables were utilized in conjunction with the set of binary variables to provide log-linear model specifications. Table III-2 describes the model in which only the continuous independent variables of the basic set of variables were transformed to the logarithmic scale. The generalized form of this specification is presented in Equation 3.2. This model produced results similar to the simple linear model. Building square footage and number of employees retained the expected signs and were statistically significant, while years at location and previous flood experience had incorrect signs and were statistically insignificant. Overall explanatory power of the model was low.

Next, using the generalized form shown in Equation 3.3, only the dependent variable was transformed into its natural logarithm, leaving all independent variables in the raw scale. As Table III-3 shows, this specification resulted in statistically significant parameter estimates and a higher value for R<sup>2</sup>. Years at location and previous flood experience once again failed to align with theoretical expectations. Analysis of content values relative to the set of independent variables indicated that the large differences in scale in variation is more appropriately handled using the logarithmic transformation of the dependent variable.<sup>6</sup>

<sup>6</sup> Indeed, this contributed to the improvement in R<sup>2</sup> under this specification.

**Linear-Log Specification**

$$\text{Content Value} = \beta_0 + \beta_1 \ln(SF) + \beta_2 \ln(EMP) + \beta_3 \ln(YEARS) + \beta_4 FLOOD \quad (3.2)$$

**TABLE III-2**  
**LINEAR-LOG SPECIFICATION PARAMETER ESTIMATES**

<b>Variable</b>	<b>Parameter Estimate (<math>\beta_i</math>)</b>	<b>T for H0: Parameter = 0</b>
Intercept	-4971157	-2.497
ln (Building Square Footage) (SF)	546282	2.100
ln (Number of Employees) (EMP)	663684	2.715
ln (Years at Location) (YEARS)	-174280	-0.687
Flooded during Agnes (FLOOD)	605203	0.938
Dependent variable: Content Value	Adjusted R <sup>2</sup> : 0.0747    F Value: 7.988	

**Log-Linear Specification**

$$\ln(\text{Content Value}) = \beta_0 + \beta_1 SF + \beta_2 EMP + \beta_3 YEARS + \beta_4 FLOOD \quad (3.3)$$

or

$$\text{Content Value} = e^{\beta_0 + \beta_1 SF + \beta_2 EMP + \beta_3 YEARS + \beta_4 FLOOD}$$

**TABLE III-3**  
**LOG-LINEAR SPECIFICATION PARAMETER ESTIMATES**

<b>Variable</b>	<b>Parameter Estimate (<math>\beta_i</math>)</b>	<b>T for H0: Parameter = 0</b>
Intercept	11.5111	78.071
Building Square Footage (SF)	0.00002	8.903
Number of Employees (EMP)	0.00719	6.023
Years at Location (YEARS)	-0.00508	-1.767
Flooded during Agnes (FLOOD)	0.36974	2.115
Dependent variable: ln (Content Value)	Adjusted R <sup>2</sup> : 0.3130    F Value: 40.408	

### Log-Log Specifications

The last linear specification that was tested utilized natural logarithmic transformations of both the dependent and continuous independent variables, as presented in Equation 3.4. Building square footage and number of employees produced statistically significant parameter estimates that aligned with expectations. As in all other specifications, the coefficients for years at location and previous flood experience had relatively high standard errors and retained unexpected signs.

The logarithmic transformations significantly diminished the scale differences among the left and right-hand sides of the equation and, as a result, provided a better model fit (Table III-4). The log-log specification was retained for further analysis.

Log-Log Specification
$\ln(\text{Content Value}) = \beta_0 + \beta_1 \ln(SF) + \beta_2 \ln(EMP) + \beta_3 \ln(YEARS) + \beta_4 FLOOD \quad (3.4)$ <p style="text-align: center; margin: 5px 0;">or</p> $\text{Content Value} = e^{\beta_0} \cdot SF^{\beta_1} \cdot EMP^{\beta_2} \cdot YEARS^{\beta_3} \cdot e^{\beta_4 FLOOD}$

**TABLE III-4**  
**LOG-LOG SPECIFICATION PARAMETER ESTIMATES**

Variable	Parameter Estimate ( $\beta_i$ )	T for H0: Parameter = 0
Intercept	6.05128	13.761
ln (Building Square Footage) (SF)	0.60889	10.600
ln (Number of Employees) (EMP)	0.43496	8.056
ln (Years at Location) (YEARS)	-0.09022	-1.610
Flooded during Agnes (FLOOD)	0.23789	1.670
Dependent variable: ln (Content Value)	Adjusted R <sup>2</sup> : 0.5739    F Value: 117.512	

### FINAL MODEL SELECTION

The log-log specification was retained as the model specification of choice for a number of reasons, and not simply because it produced a higher R<sup>2</sup>. Recall that model specifications utilizing raw-scale estimation of content values were found to have insufficient explanatory power and were rejected. The two remaining models with logarithmically-scaled dependent variables (i.e., log-linear and log-log) have very different characteristics. The log-linear specification produces an exponential estimate of content value that is very sensitive to higher values for the independent variables. On

the other hand, polynomial forms created using log-log models produce content value estimates that are less sensitive to higher values of the independent variables. Thus, the log-log specification is expected to generate less volatile predictions outside of the bounds of the original data set. Also, the log-log specification is aligned intuitively with the observed characteristics of content value relative to the independent variables. For example, as the number of employees increases, the addition of 1 additional employee does not increase content value in a linear or exponential manner, instead each additional employee requires slightly less equipment. Finally, the log-log specification allows direct interpretation of the parameter estimates as elasticities.

Using the final log-log specification, the full array of potential independent variables identified earlier were analyzed in various combinations along with the basic variables: square footage, number of employees, and years at location. Each combination offered both advantages and disadvantages. Examination of alternative variable combinations indicated maximum  $R^2$  values ranging from 0.58 to 0.62, with significant  $F$ -values.

Aside from the basic variables, other variables identified earlier were tested in the regression process in both raw and logarithmic scale using the natural logarithm of content value as the dependent variable. The variables denoting the number of buildings at the location and number of stories were consistently insignificant and failed to have alignment with expected relationships (incorrect sign). Furthermore, statistically insignificant  $t$ -scores were repeatedly obtained for the variables that denoted the existence of a basement and flood insurance. The number of years at location and indicators of previous flood experiences were dropped because they continually failed to align with theoretical expectations for the parameter signs and did not meet customary statistical significance levels. Some categorical variables for the major SIC groupings and individual SIC groups were also tested and eliminated over concerns of sample size and low significance. In many cases it was unclear whether the parameter estimates represented the attributes of entire groups or whether they were overly influenced by the unique characteristics of individual observations.

The analysis produced three potential final content value models. Alternative A, below, utilizes natural logarithmic transformations of building square footage, number of employees and depreciated structure replacement value, along with binary variables denoting businesses in the manufacturing, finance, and service sectors. Although square footage and replacement value are highly correlated (Table B-2 of Appendix B), the magnitudes of their individual  $t$ -values suggests that they each have very strong independent effects on content value. Alternative A explains approximately 60 percent of the total variance in the content value (Table III-5).

Alternative B replaces the binary variables for manufacturing and services establishments with a set of variables that identify five 2-digit SIC groups with relatively large sample sizes (Table III-6). While the five SIC binary variables represent relatively large sample sizes for individual business groups, the authors urge readers not to overlook the possibility that the variables capture business-specific characteristics and not group-specific characteristics. Finally, Alternative C trades a slight decrease in overall explanatory power for a more parsimonious variable specification (Table III-7). Despite the differences in the configuration of binaries for SIC groups, the coefficients for building square footage, number of employees, and structure replacement value do not vary greatly

among the three alternatives. Recall that one advantage of the log-log specification is that the parameter estimates can be interpreted as elasticities. For example, Alternative C indicates that a 10 percent increase in building square footage results in a 3.5 percent increase in building content value. Interestingly, the other variables in the model have very similar elasticities.

## SUMMARY

This chapter identified the criteria for developing a statistical model for estimating nonresidential building content values. Three alternative functional specifications of the model were identified. The log-log specification utilizing logarithmic transformations of the dependent variable and all continuous independent variables is recommended, as is the use of building square footage, depreciated structure replacement value, and the number of employees as independent variables. Adding indicator variables for SIC groups may provide extra benefits for content valuation, however this should be verified through actual application and verification of the three recommended alternatives described above.

**TABLE III-5**  
**ALTERNATIVE A**

<b>Variable</b>	<b>Parameter Estimate (<math>\beta_i</math>)</b>	<b>T for H0: Parameter = 0</b>
Intercept	3.56395	5.520
ln (Building Square Footage)	0.22025	2.650
ln (Number of Employees)	0.30010	5.397
ln (Replacement Value)	0.49430	5.600
Manufacturing	0.79395	3.646
Finance	-0.49408	-1.707
Services	-0.25825	-2.052
Dependent variable: ln (Content Value)	Adjusted R <sup>2</sup> : 0.5996 F Value: 93.344	

**TABLE III-6  
ALTERNATIVE B**

<b>Variable</b>	<b>Parameter Estimate (<math>\beta_i</math>)</b>	<b>T for H0: Parameter = 0</b>
Intercept	3.617712	5.616
ln (Building Square Footage)	0.301114	3.851
ln (Number of Employees)	0.353923	6.377
ln (Replacement Value)	0.432053	5.065
SIC56	0.638824	2.229
SIC58	-0.834098	-4.267
SIC79	-1.073971	-3.049
SIC82	-0.949863	-2.692
SIC86	-0.593286	-2.176
Dependent variable: ln (Content Value)      Adjusted R <sup>2</sup> : 0.6175      F Value: 75.681		

**TABLE III-7  
ALTERNATIVE C**

<b>Variable</b>	<b>Parameter Estimate (<math>\beta_i</math>)</b>	<b>T for H0: Parameter = 0</b>
Intercept	3.99147	6.123
ln (Building Square Footage)	0.35390	4.412
ln (Number of Employees)	0.35697	6.416
ln (Replacement Value)	0.35353	4.151
Dependent variable: ln (Content Value)      Adjusted R <sup>2</sup> : 0.5782      F Value: 170.081		



---

## CHAPTER IV. SECONDARY SOURCES OF BUSINESS CONTENT DATA



In order to supplement the survey-based statistical approach to estimating business content values, a number of other secondary sources were referenced. In general, the search for information focused on three potential sources: (1) insurance companies, (2) published government statistics, and (3) private/commercial data services. These secondary sources of information are reviewed in independent sections below. Recommendations are made with regard to their potential use in estimating nonresidential content value for Corps flood control planning studies.

### INSURANCE INDUSTRY

For residential homeowner's insurance policies, insurance companies have typically employed rules of thumb in estimating coverage of household contents (Davis, 1993). Residential content coverages are normally established as a percentage of the depreciated replacement value of the housing structure. Historically, residential content-to-structure (C/S) ratios have ranged from 40 to 75 percent of depreciated structure replacement value, depending on the time period and the insurance carrier.

Some of the largest casualty insurance companies in the United States were contacted in order to learn if the same techniques and rules of thumb have been used in underwriting nonresidential business policies (or commercial risks). The following insurance companies were contacted:

- (1) Aetna Insurance; Hartford, Connecticut
- (2) Allstate Insurance Company; Northbrook, Illinois
- (3) Farmers Insurance Group; Los Angeles, California
- (4) Liberty-Mutual Insurance Company; Boston, Massachusetts
- (5) Nationwide Insurance Company; Columbus, Ohio
- (6) State Farm Insurance Company; Bloomington, Illinois

Discussions with a number of commercial underwriters, actuaries, and sales representatives of these companies indicated that the insurance industry does not normally apply standard rules (e.g., C/S ratios) in determining nonresidential content coverage. Determining insurance policies for businesses typically requires more in-depth analysis than in the residential sector, because of varying business activities even among businesses that provide similar services (Carlson 1995). Furthermore, separately determined limits for structure and for contents are often preferred, since the value of business contents, such as inventories and equipment, are generally known by the

insured. The value of some business contents are directly related to a business's tax liability (Carlson 1995).

State Farm Insurance Company typically relies on business applicants to review and provide the value of business records, inventory, and business equipment (Compton 1995). Also, the majority of the commercial risks underwritten by State Farm are tenant policies, in which shopkeepers rent buildings or office space for their businesses. Therefore, there is often no direct connection between the value of business contents and the value of the structure, because the structure is underwritten on a separate policy and under a different name.

Allstate Insurance has compiled internal statistics on business content values that are used to define normal ranges of content coverage by customer class (Heiden 1995). However, Allstate officials cautioned that the benchmarks were not actually used to estimate building content values, but rather to guide managers in determining who within the corporation should underwrite the policy (Carey 1995). Because of the wide variability among the benchmarks, the Allstate business content standards were not considered appropriate for publishing in this report (Carey 1995).

### **Other Insurance Organizations**

In order to confirm the information obtained from insurance companies, other insurance organizations were contacted. Insurance Services Offices (ISO, New York, New York), an advisory organization for the insurance industry, and its subsidiary, Commercial Risk Services (CRS, Chicago, Illinois), both verified that there are not any standard tools used for calculating the appropriate coverage for business contents. The Insurance Information Institute (New York, New York) reiterated this theme, and indicated that a generic set of C/S ratios likely could not be developed, because of the preponderance of tenant policies. Furthermore, it was suggested that even if benchmarks such as C/S ratios could be developed, they should not be used because of the wide variation in content values among businesses (Manning 1995). According to the Institute, it remains in the best interests of the insured and the insurer to have a precise estimate of content value, regardless of whether the policy is residential or nonresidential. A representative of the statistical branch of the National Flood Insurance Program agreed, and mentioned that commercial property risks had always been approached through appraisal by the owner of the property (Lalley 1995).

### **PUBLISHED GOVERNMENT SOURCES**

Various U.S. Department of Commerce publications were also reviewed for generalized information on business contents. Unfortunately, these sources did not provide direct summary statistics on the average value of business contents by business class. However, a limited amount

of data on the value of business inventories and industrial equipment are available, along with other data that may be related to movements in business content value over time.

### **Retail and Wholesale Industries**

The Statistical Abstract of the United States 1992 provides average sales to inventory ratios by type of business (SIC) for the retail and wholesale sectors. These ratios are defined as annual year inventory may not be appropriate for estimating business inventory for flood damage avoidance projects.

The Revised Monthly Retail Sales and Inventories provides a monthly time series of sales to inventory (S/I) ratios for the 1981 to 1989 time period by retail SIC class. The S/I ratios that are reported are much smaller than those reported in the Statistical Abstract, since monthly sales and inventories are used rather than annual total sales and end-of-year inventories. Adjusted for seasonal fluctuations in product demand, the retail S/I ratios remained relatively stable over the 1980s. For example, for retail trade as a whole, the S/I ratio varied from a minimum of 1.42 to a maximum of 1.62 over this period of general economic expansion. Over the business cycle, market adjustments would be expected to regulate the S/I ratio to a narrow range of values. Thus, given information on sales for a particular retail establishment, the long-term (20 or 30 year) average ratio of sales to inventory could be used to estimate the value of inventory, which is only one, but an important, component of total business content value.

### **Manufacturing**

The Statistical Abstract of the United States provides similar sales and inventory information for the manufacturing sector. While the Abstract does not provide any clear-cut information on content value, time-series data are available for value of inventory and value of shipments, allowing the computation of sales to inventory (S/I) ratios by SIC. Limited time-series data are also available that identify the portion of total aggregate capital invested in equipment, structures, and inventories. These data might allow the computation of sectoral ratios of equipment to total value, inventory to total asset value, and structure to total asset value ratios.

The 1992 Census of Manufactures provides beginning and end of year gross book values of structures and equipment by SIC, in addition to total value of shipments by SIC. The combination of these data allow the computation of equipment to shipment and structure to shipment ratios. Sample data obtained during the Census provided a breakdown of machinery and equipment expenditures into three subcategories: vehicles, computers and data processing equipment, and all other equipment. Trends in industry expenditures could be examined to determine the proportion of new equipment by type by SIC. The Census of Manufactures is also available by geographic area

(usually states). However, the data examined in the geographic series were not disaggregated by SIC, thus limiting its potential for estimating nonresidential content values.

### COMMERCIAL DATA SOURCES

In addition to the readily available government sources, several private commercial sources of business content values were investigated, including:

- Dun & Bradstreet Information Services
- Moody's Investors Service
- Robert Morris Associates
- *Ward's Business Directory of U.S. Private and Public Companies*
- Marshall & Swift

Moody's Investor Services and Robert Morris Associates show some promise in estimating at least one of the key relationships necessary to compute nonresidential business content values. Moody's Investors Service, a subsidiary of Dun & Bradstreet, provides income, equipment, and inventory data for individual business firms. Data from Moody's could potentially be used to estimate sales to equipment and sales to inventory ratios for selected sample firms. The major difficulty would be in determining the contribution of individual facility's share of total equipment, inventory, and sales within a conglomerate corporation's statement. Robert Morris Associates provides analyses of annual business statements by SIC. Analysis of over 400 different industries are provided in the Annual Statement Studies, with each industry categorized by asset size and by total sales. The report provides data necessary to estimate sales to inventory ratios.

Dun & Bradstreet Information Services provides a database service of commercial businesses. The database contains business address, sales information, employment data, year established, and SIC. By themselves, these data are not sufficient to generate any useful relationships for the estimation of content values. However, it appears to provide an excellent source for identifying businesses to be targeted for any future survey efforts. Ward's provides business rankings by total revenue or number of employees within each SIC or within specific geographic regions. Data obtained from this source is insufficient to estimate any useful building content relationships.

The most promising single source of building content value estimates is Marshall & Swift. Marshall & Swift provide a wide range of appraisal and assessment services to developers, realtors, and insurance carriers. Marshall & Swift, in combination with Oxford Information Technologies, anticipate the release of a new software package, Commercial Contents and Inventory (CCI), capable of estimating the value of commercial building contents. The software is based on over 12 million records obtained from the Internal Revenue Service, Dun & Bradstreet, and the banking industry (Stawicki 1995). The software is Windows-based and is expected to cost around \$1,500 for the first

copy, with discounts for additional copies. The scheduled release date for the program is tentatively slated for March 1996.

The software will allow user input of capital depreciation rates and will be updated quarterly. CCI will generate estimates of equipment and inventory replacement costs by 4-digit SIC, based on:

- geographic location (zip code)
- annual gross revenue
- size in square feet
- year business started
- number of production shifts per day (1, 2, or 3)
- relative density of equipment within building (low, average, crowded)
- equipment quality (low, standard, high)
- number of inventory turnovers
- number of employees

Except for the number of inventory turnovers, all input parameters are required to generate an estimate of content value. However, local or regional mean values may be used for many variables when exact values are unknown. For required input parameters, a knowledge-based system is employed to provide advice on the normal ranges for variables. For example, if a particular variable such as building area does not align with the other input parameters, the software will notify the user of the normal range for the variable. The user can select from within the normal range or manually override to keep the original parameter. The program also contains a SIC Navigator to allow accurate selection of the appropriate 4-digit SIC code based on keyword searches. Most all parameters can be obtained through the use of surveys similar to the Wyoming Valley Survey. Required gross revenue data for the software can be obtained from the Internal Revenue Service.

## **SUMMARY**

A thorough search of additional potential sources to aid the Corps in estimating building content values was conducted, including the insurance industry, published government documents, and commercial enterprises. The results of the search were mixed.

- Commercial insurance carriers do not use content to structure ratios. Discussions with underwriters and agents in the insurance industry indicated that individual firms provide estimates of content values, which are then fully insured. This method is preferred due to the wide range of business activities and size of firms within the nonresidential sector.

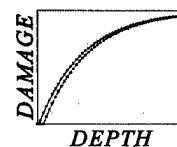
## **SECONDARY SOURCES OF BUSINESS CONTENT DATA**

---

- Documents published by the Department of Commerce provide limited industry-wide information on the value of sales, inventories, and equipment by SIC. Given data on sales and/or value of shipments, ratios can be established in order to estimate inventory and equipment value. However, these data are based on national averages and may not be directly transferable to particular geographic regions or to particular business establishments (Moser and Berry 1977).
- Marshall & Swift is expected to release a software program that may be directly applicable to Corps flood control studies. This program is designed to estimate content values of commercial businesses by SIC based on location, revenue, building size, year of construction, and number of employees. Conceptually, this program can be used in conjunction with data supplied by local building and tax records, local Chamber of Commerce records, Dun & Bradstreet Information Services, and/or additional flood damage surveys.

---

## CHAPTER V. DEPTH-DAMAGE FUNCTION ESTIMATION



The depth-damage function is the primary relationship used to estimate flood damages. A structure *depth-damage function* is defined as a relation between structure damage, taken as a percentage of structure value, and the level of flood water with respect to the first floor. Similarly, *content depth-damage functions* estimate the percent of building contents damaged relative to total content value, as dependent on flood water with respect to the first floor. These relationships are used in conjunction with content valuation methods and building replacement values to generate total damages resulting from each foot of flooding.

During the Wyoming Valley survey, hypothetical damages for four discrete flood levels (1 ft., 4 ft., 8 ft., and 12 ft) were obtained. Additionally, building characteristics such as the number of stories and existence of a basement were gathered. As expected, building characteristics help determine the extent of damages for each foot of flood water, i.e., buildings with a basement experience higher content and structure damages than those with no basement. Analysis of previous depth-damage research in the residential sector also provided insights into the nature of flood damages, and how damages relate to building characteristics (Davis, 1993; Davis and Skaggs, 1992).

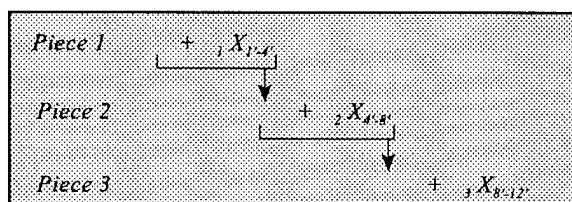
### STRUCTURE DEPTH-DAMAGE FUNCTIONS

Early research into structure depth-damage estimation plotted mean damage levels at discrete flood levels for each building type. Analysis of these plots suggest that depth-damage functions are not simple linear relationships which have damage increasing at constant rates for each foot of flooding. Instead, the plots show significant damages occurring at low flood levels with a decreasing rate of damages over each additional foot of flood water.

Initial depth-damage function specifications tested simple linear models, models of linear regression by parts, and nonlinear models. Examination of specifications of depth-damage functions based on least-squares linear regression proved less than optimal with increasing depth. These models estimated a persistent seven percent increase in percent damage with each foot of inundation. Using this fixed parameter estimate, percent damage quickly exceeded the acceptable range. Additionally, estimates from these models could not be reconciled with plots of damages at discrete flood levels. As a result, specifications based on simple linear models were rejected.

Next, piece-wise linear models were tested. Using the four hypothetical flood damage levels provided by the survey, the dataset was divided into three data subsets. The first subset contained only flood damages for flood levels of 1 foot and 4 feet, the second subset contained damages

incurred at flood levels of 4 feet and 8 feet, and the third subset contained damage values only for flood levels of 8 feet and 12 feet. Within each data subset, a linear model of flood damage was estimated as a function of flood depth using linear regression. Restrictions were applied to the intercepts in the following manner: the intercept of the second model (4 to 8 feet) was fixed as the value predicted by the first model, and the intercept of the third model (8 to 12 feet) was determined by the outcome of the second model. This sequence is illustrated by Figure V-1. This iterative procedure resulted in a continuous, piece-wise linear model describing the depth-damage relationship.



**Figure V-1. Piece-Wise Regression Procedure**

Parameter estimates obtained from this specification produced depth-damage functions that more closely aligned with plots of actual mean damage levels at specific flood levels. Structure damages were estimated to rise approximately eight percent per foot ( $\beta_1$ ) for flood levels between one and four feet, five percent ( $\beta_2$ ) between four and eight feet, and then three percent ( $\beta_3$ ) for flood levels between eight and twelve feet. The composite of the three linear models provided a closer fit than the simple linear model. However, because of its linear nature, this specification was incapable of estimating the decreasing rate of damages for higher flood levels above 12 feet. The results of the piece-wise linear model suggested that the true form of the depth-damage function is nonlinear and approximated by a negative exponential asymptotic growth curve. Therefore, a nonlinear specification based on negative exponential growth in percent damage relative to depth was developed as another alternate specification.

The negative exponential asymptotic growth curve of Equation 5.1 is characterized by an asymptotically vanishing rate of growth with increasing independent variables,  $x_1$  and  $x_2$ . As the magnitude of the independent variable increases, the rate of increase in the dependent variable slows. As the independent variable continues to increase, the dependent variable approaches a maximum value (asymptote) represented by  $\beta_0$ .

$$\text{Dependent Variable} = \beta_0 \cdot \left( 1 - e^{-\beta_1 \cdot x_1} \cdot e^{-\beta_2 \cdot x_2} \right) \quad (5.1)$$

Examination of negative exponential depth-damage functions closely aligned with plots of mean actual damages at specific flood levels. This specification also provided the ability to extrapolate beyond the one to twelve foot flood levels used to create the function. Estimation of the exponential model was undertaken using nonlinear least squares. Nonlinear least squares is an iterative technique that examines squared residuals over a grid of possible parameter estimates. The set of parameters that minimizes the sum of squared residuals make-up the nonlinear model.

Once the general nonlinear negative exponential growth specification was selected, variants of the model were specified to include particular building characteristics, such as the existence of a basement and number of stories in the building. The presence of a basement in a building was found to significantly alter flood damage estimates for lower levels of flooding. However, damages to structures (with and without basements) converged at approximately 72.0 percent of structure value with complete inundation (24+ feet above the first floor).

The model was further analyzed to identify any differences in the depth-damage relationship with respect to the number of stories. Iterations of the general nonlinear model were conducted by number of stories. Slight decreases in maximum potential damage were observed for buildings with more than three floors, however, the number of observations in each class was not sufficient to provide meaningful interpretation. Thus, a binary variable (0= single story, 1= 2+ stories) was created to differentiate single and multi-story buildings. Analysis of this parameter indicated no significant differences in model coefficients and performance. Therefore, the following model for estimating the percent structure damage based on a negative exponential growth function is recommended:

$$\% \text{ Structure Damage} = 0.7200 \cdot \left( 1 - e^{-0.1332 \cdot \text{depth}} \cdot e^{-0.0983 \cdot \text{basement}} \right) \quad (5.2)$$

where:

- $e$  = Base of the natural logarithm
- depth = Depth of flood water relative to the first floor (in feet)
- basement = Binary variable (0 = no basement present, 1 = basement present)

Figure V-2 presents the plotted structure depth-damage function over a continuous range of flood elevations. SIC-specific models and associated plots are presented in Appendix D for the two-digit SIC groups that have larger sample sizes.

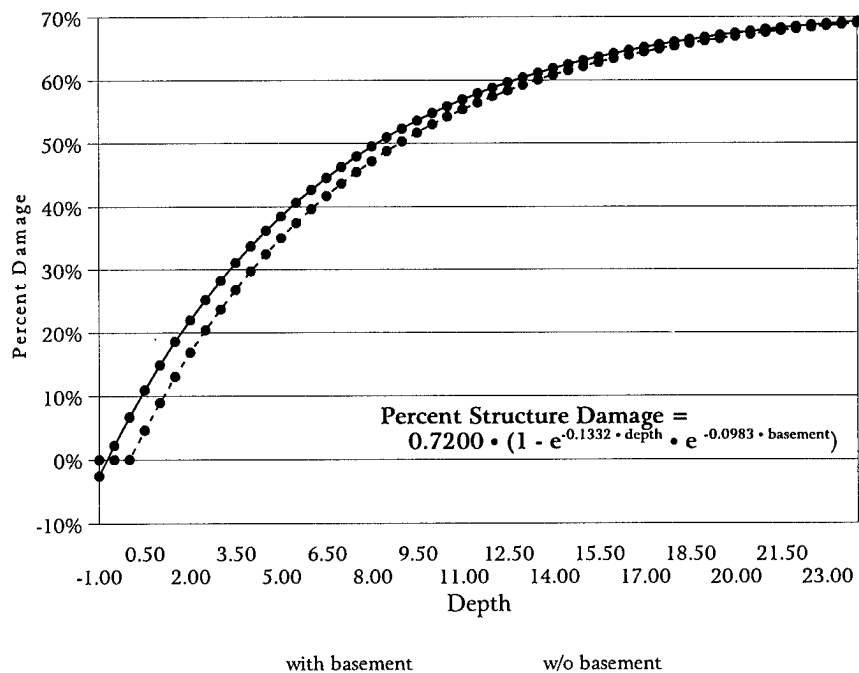


Figure V-2. General Model of Structure Depth-Damage Function

### Content Depth-Damage Functions

Derivation of statistical models for estimating content depth-damage relationships proceeded similarly to the development of structure depth-damage functions. Analysis of basic data, such as mean damage at discrete flood levels, indicated that content damages rose dramatically at lower flood levels with smaller increases in total percent damaged with each foot of water at higher flood levels. The simple linear specification could not account for the change in the rate of damages. Thus, specifications involving simple linear models were eliminated.

The data for building content depth-damage estimation were then examined utilizing a piece-wise linear model (i.e., the function was divided into three flood level intervals: 1-4 feet, 4-8 feet, and 8-12 feet). Analysis of the results produced by this specification suggested that damages increase for flood levels below four feet, then increase less rapidly between four and eight feet, and then level-off at about twelve feet. The slope of the piece-wise function was 8.6 percent, 1.3 percent, and 0.4 percent for each respective interval. Still, this specification presented difficulties in extrapolating to flood levels not included in the estimation process. The piece-wise formulation was subsequently rejected.

A nonlinear specification based on the negative exponential asymptotic growth curve was then examined. This model produced a function that more closely aligned with the plotted means of content damages at discrete flood levels. It also provided a better estimation of damages for flood levels above and below the hypothetical flood levels examined in the Wyoming Valley survey. This specification was retained for further analysis.

The nonlinear specification for content depth-damage estimation was tested for significant differences based on the presence of a basement and on the number of stories in the building. The limited number of observations for individual building configurations required the aggregation of buildings into two building configurations, single story and multi-story. Analysis of the results indicated significant differences in percent of contents damaged between single and multi-story buildings. This finding is consistent with a proprietor's initial reaction to flooding—moving valuable contents to upper floors away from rising flood waters. Similar to the analysis of structure damages, the presence of a basement increased the level of damages at the lower flood levels. The equations below present the nonlinear content depth-damage models for single story structures and for buildings with more than one story:

$$\begin{aligned} \% \text{ Content Damage} &= 0.7102 \cdot \left( 1 - e^{-0.3736 \cdot \text{depth}} \cdot e^{-0.0595 \cdot \text{basement}} \right) && \text{(single story)} \\ \% \text{ Content Damage} &= 0.7717 \cdot \left( 1 - e^{-0.3223 \cdot \text{depth}} \cdot e^{-0.1910 \cdot \text{basement}} \right) && \text{(multi story)} \end{aligned} \quad (5.3)$$

where:

- $e$  = Base of the natural logarithm
- depth = Depth of flood water relative to the first floor (in feet)
- basement = Binary variable (0 = no basement present, 1 = basement present)

Figures V-3 and V-4 present the plotted depth-damage functions for building contents for single story and multi-story structures, respectively. Appendix E presents individual content depth-damage functions for each of the eight two-digit SIC groups with relatively large sample sizes.

## SUMMARY

This chapter discussed three potential specifications of depth-damage functions for estimating percent structure and building content damage. Simple linear and piece-wise linear specifications were rejected in favor of a nonlinear specification based on the negative exponential asymptotic growth curve. Buildings having a basement tended to have higher damages for the lower flood levels, with differences diminishing with increased flood levels. No significant differences

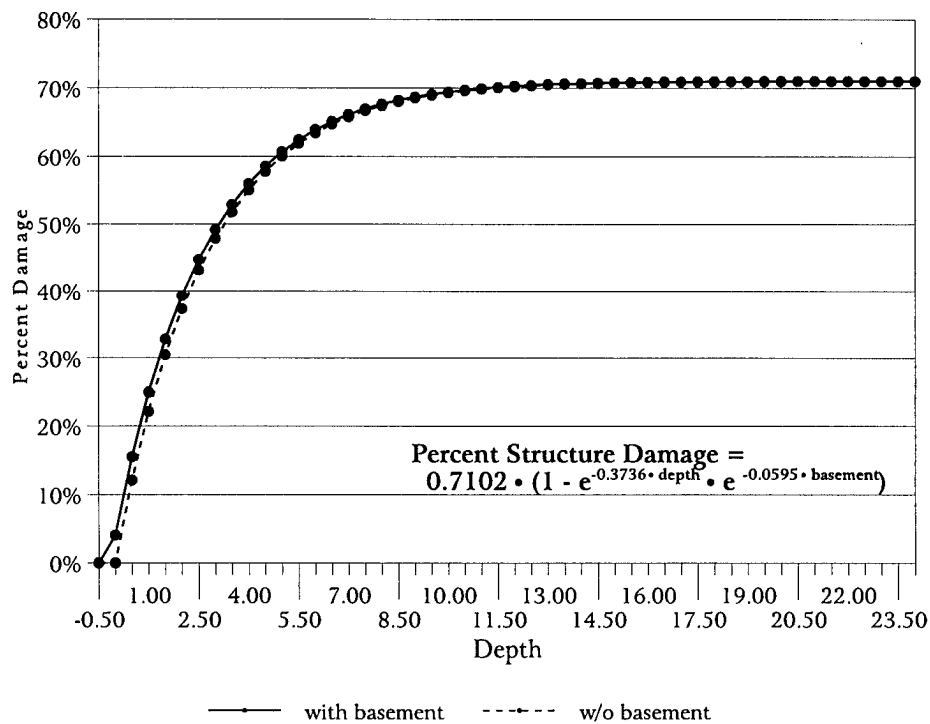


Figure V-3. General Content Depth-Damage for Single-Story Buildings

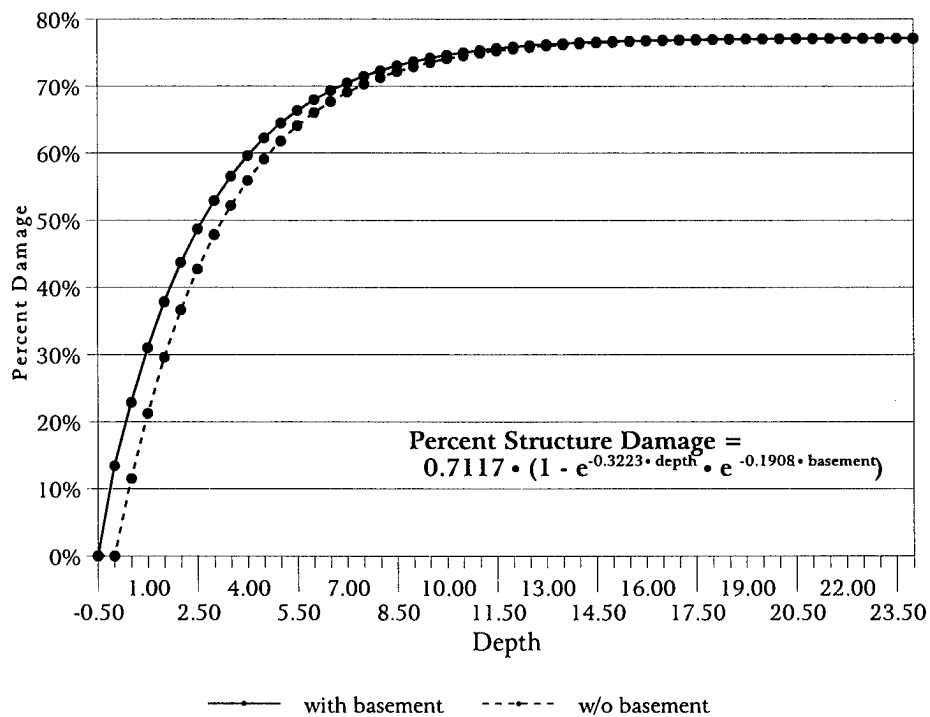


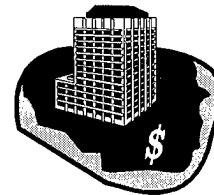
Figure V-4. General Content Depth-Damage for Multistory Buildings

were observed for estimating structure depth-damage relationships based on the number of stories in the building. However, content depth-damage relationships were found to be dependent on the number of stories in the building. Thus, estimation of building content depth-damage relationships requires separate models for single and multi-story buildings.



---

## CHAPTER VI. CONCLUSIONS AND RECOMMENDATIONS



### SUMMARY AND CONCLUSIONS

This study produced several key relationships that can help the Corps estimate flood damages in the nonresidential business sector. Based on information gathered from the Wyoming Valley survey, the following information was derived:

- Content value-to-structure value (C/S) ratios for the entire sample and for 3-digit SIC groups
- Content valuation functions that predict the value of inside contents based on readily available information on square footage, number of employees, and depreciated structure replacement value
- Structure depth-damage functions that predict damages to buildings over a range of flood depths
- Content depth-damage functions that predict damages to the contents of buildings over a range of flood depths

These relationships can be used in a variety of combinations in support of feasibility analyses of flood control projects. Given local data on nonresidential structure values, the C/S ratios provided in Appendix B may be used to generate nonresidential content values. If more detailed data on square footage and the number of employees is available, the analyst also has the option of predicting content value using the content valuation functions presented in Chapter III. Content values may also be estimated using secondary sources of data, such as the commercially available content valuation software from Marshall & Swift. Next, the content depth-damage functions of Chapter V and Appendix E can be used to generate the percentage of content damages that would be expected over a range of assumed flood depths. Then, in conjunction with the prediction of content value, the output of the depth-damage function may be used to infer dollars of content damage for a range of assumed flood depths. Finally, given local data on structure values, the structure depth-damage functions of Chapter V and Appendix D can be used directly to infer dollars of structure damage over a range of flood depths.

Although this research provides convenient tools for assessing important components of nonresidential flood damages, the results of this study may not be very transferrable outside of the Wyoming Valley sample. Concerns over potential differences in damage and value estimates by geographic region, as well as the composition of the nonresidential business sector in other

floodplains potentially restrict the use of these results for other regions of the nation. Unfortunately, small sample sizes for particular types of business activity and large sample variation cannot lead to robust results. Therefore, readers are urged to verify the results of this study wherever possible, through the use of local surveys and other available sources.

## RECOMMENDATIONS

Research in the area of nonresidential flood damage assessment should continue to be focused toward providing efficient and reliable means of estimating potential flood damages. Two key components of estimating potential flood damages are valuation of contents and structure and identification of applicable depth-damage relationships for both structure and contents. Forthcoming commercially developed software from Marshall & Swift provides the best potential for assessing nonresidential building content values. In conjunction with this software, further study of depth damage relationships should be undertaken. Properly targeted nonresidential business surveys offer the greatest potential for providing the data necessary to develop robust models of depth-damage relationships. The Wyoming Valley survey should be considered only the first step in the nonresidential data collection process.

A recommended course of action for nonresidential content value estimation would be to utilize the forthcoming Marshall & Swift commercial valuation program in conjunction with refined depth-damage relationships. The software is designed to estimate content values of commercial businesses by SIC, based on location, gross revenue, building size, year of construction, and number of employees. This information can be made available through additional local surveys and through other commercial services such as Dun & Bradstreet.

The second major recommendation is that the Corps conduct a set of nonresidential flood surveys in order to gather data for the formulation of content value and depth-damage functions. Specifically, these surveys should:

- (1) Target cities/regions that have been flooded within the past year. Timeliness of a flood damage survey is critical. Respondents will have an easier time remembering more recent events, and, therefore, will likely provide more accurate information on damages and other important information. The 20-year period that had elapsed since the flooding of Tropical Storm Agnes is probably to blame for some of the discrepancies found in responses to the Wyoming Valley survey.
- (2) Target separate geographical areas simultaneously. Simultaneous implementation of, for example, 5 to 10, surveys in different areas in the United States would likely provide a sufficiently large number of observations to estimate robust content value and depth-damage relationships. Geographical stratification of the surveys would serve at least two purposes. First, different areas will likely have different mixes of industry and business activity.

Second, different topographies and land uses may have significantly different depth-damage relationships, which is a hypothesis worth testing.

- (3) Target specific types of businesses. A major shortfall of the Wyoming Valley survey was that sample sizes for most types of business activities (SIC's) were very small, and far too small for meaningful statistical inference. Sample stratification with respect to 2 and 3 digit SIC groups would help alleviate this problem, and would provide an opportunity to develop unique depth-damage functions for specific business activities. It would be possible to selectively target the survey to focus on industries based on total value added, number of employees, and geographic location (flood risk). Selective targeting should result in more accurate estimates for SICs with higher contributions to total expected annual damages.
- (4) Elicit damages for flood depths below the first floor. The Wyoming Valley survey gathered information on property damage for discrete flood depth intervals above the first floor. Because damages can occur in basements, flood depth intervals should be added to encompass damages below the first floor.
- (5) Rely on site inspections, if possible. Persons not familiar with flooding may have difficulty in forming responses to important questions. Furthermore, as found in the Wyoming Valley survey, survey questions can be misinterpreted. Depending on cost, on-site inspections by trained personnel would provide important background information on the objective of the surveys a built-in means of validating survey responses.

Finally, it is recommended that the current Wyoming Valley questionnaire be re-designed for any future survey effort. The Corps should design a questionnaire that minimizes the likelihood of error and/or misinterpretation, at the same time that it gathers the maximum amount vital of information. Concurrently, the Corps should contemplate the type of sampling plan that would be required to implement the types of sample stratification recommended above.



---

## REFERENCES

- Baltimore District. US. Army Corps of Engineers 1995. *Wyoming Valley Levee Raising Project - Final General Design Memorandum, Phase II*. Baltimore, Maryland
- Carlson, Chris. Nationwide Insurance Company, Columbus, Ohio. Personal communication. 1995.
- Cary, George. Allstate Insurance Company, Northbrook, Illinois. Personal communication. 1995.
- Compton, Alan. State Farm Insurance Company, Bloomington, Illinois. Personal communication. 1995
- Davis, Stuart. *Guidelines to Estimating Existing and Future Residential Content Values*. U.S. Army Corps of Engineers Water Resources Support Center Institute for Water Resources, Fort Belvoir, Virginia. 1993.
- Davis, Stuart and Leigh Skaggs. 1992. *Catalog of Residential Depth-Damage Functions Used by the Army Corps of Engineers in Flood Damage Estimation*. U.S. Army Corps of Engineers Water Resources Support Center Institute for Water Resources, Fort Belvoir, Virginia.
- Heiden, Patricia. Allstate Insurance Company, Northbrook, Illinois. Personal communication. 1995.
- Kennedy, Peter. 1986. *A Guide to Econometrics (2nd edition)*. Cambridge, Massachusetts: MIT Press.
- Lalley, Thomas. National Flood Insurance Program, Statistical Bureau. Personal communication. 1995
- Manning, Betty. Insurance Information Institute, New York. Personal communication. 1995.
- Moody's Industrial*. Volume 67, Number 5. New York: Moody's Investors Services. August 1995.
- Moser, D.A. and C.A. Berry. *Empirical Investigation of the Existence and Magnitude of a Commercial and Industrial Affluence Factor*. Prepared for the U.S. Army Engineer Institute for Water Resources, Fort Belvoir, Virginia. September 1977.
- Sims, J.H. and D.D. Baumann. 1983. "Educational Programs and Human Response to Natural Hazards," *Environment and Behavior*, Vol. 15, No. 2, pg. 165.

## REFERENCES

---

- Slovic, P., H. Kunreuthor, and G.F. White. 1974. "Decision Processes, Rationality, and Adjustment to Natural Hazards" in *Natural Hazards: Local, National, Global*, edited by G.F. White, Oxford University Press: New York.
- Sorkin, A.L. 1982. *Economic Aspects of Natural Hazards*; D.C. Heath and Company. Lexington, Massachusetts.
- Stawicki, Matthew. Director of Key Accounts, Marshall & Swift. Princeton, New Jersey. Personal communication. 1995.
- U.S. Department of Commerce. *1992 Census of Manufactures- Geographic Series*. Prepared by the Economics and Statistics Administration, Bureau of the Census, Washington, D.C. 1992.
- U.S. Department of Commerce. *1992 Census of Manufactures- Industry Series*. Prepared by the Economics and Statistics Administration, Bureau of the Census, Washington, D.C. 1992.
- U.S. Department of Commerce. *Revised Monthly Retail Sales and Inventories: January 1980 Through December 1989*. Prepared by the Economics and Statistics Administration, Bureau of the Census, Washington, DC. April 1990.
- U.S. Department of Commerce. *Statistical Abstract of the United States 1992*. Prepared by the Economics and Statistics Administration, Bureau of the Census, Washington, D.C. 1992.
- U.S. Department of Commerce. *Survey of Current Business*. Volume 75, Number 5. Prepared by the Economics and Statistics Administration, Bureau of the Census, Washington, D.C. May 1995.
- Ward's Business Directory of U.S. Private and Public Companies*. New York: Gale Research Inc. 1995.
- Willett, J.S. 1995. *Perception, Decision, Response: Lessons Learned in the Flood of 1993*. Masters Thesis. Southern Illinois University at Carbondale, Carbondale, Illinois.
- Yoe, Charles. 1991. *Non-Residential Survey Sampling Options for Wyoming Valley, Pennsylvania*. Prepared for the U.S. Army Corps of Engineers, Baltimore District, Economics Branch.

**APPENDIX A**

**WYOMING VALLEY SURVEY INSTRUMENT**



**WYOMING VALLEY  
NON-RESIDENTIAL FLOOD DAMAGE SURVEY**

1. Interview Number .....
  2. Map, Block, and Lot Numbers ..
  3. Interviewer .....
  4. Community .....
  5. Name of Business .....
  6. Type of Use .....
  7. SIC # .....
  8. Street Address .....
  9. City & Zip .....
  10. Contact Person .....  
(Name and Title)
  11. Phone Number .....
- 
- 

12. Number of Major Buildings .....  
(See Guidelines)

13. Number of Employees.....  
Full Time  
Part Time

14. What year was your business established at this location? .....

15. Was this business flooded during Tropical Storm Agnes?  
Please Circle. 0. No 1. Yes  
If no skip to question 18.

16. How high was the water relative to the first floor of this building? ..... Feet  
(+ or -)

17. How many days was this business closed due to Tropical Storm Agnes? ... Days

>18. Do you have flood insurance on your structure? ..... 0. No 1. Yes

19. Do you have flood insurance on your contents? ..... 0. No 1. Yes

20. Do you maintain your own self-insurance fund? ..... 0. No 1. Yes

21. What, if any, major renovations/improvements have you undertaken in the last five years to update or expand your operations?

---

---

---

22. Do you have any plans for improvements over the next five years to expand or update your operations?

---

---

---

23. How much warning time did you have prior to the 1972 flood? ..... \_\_\_\_\_ hours  
..... \_\_\_\_\_ days

24. What actions, if any, did you take to safeguard your business property?

---

---

---

25. What percent of your potential damages did you prevent? ..... \_\_\_\_\_ percent

26. How much warning time would you need remove all of the transportable contents of this building?

..... \_\_\_\_\_ hours  
..... \_\_\_\_\_ days

---

---

## INDIVIDUAL BUILDING DATA

1. Building Number .....  
(start with largest building)

**Please note in the questions below that present in-kind replacement value refers to the replacement value (in 1992 prices) of an item minus the percentage of value that has been lost because of deterioration in condition.**

2. What is the present in-kind replacement value all structural elements of this building? ..... \$
3. What is the present in-kind replacement value of all business-related equipment not physically attached or anchored to this building? ..... \$
4. What is the present in-kind replacement value of all inventory and raw materials generally stored in this building? ..... \$
5. What would you consider to be the dollar value of business records generally stored in this building? ..... \$
6. What is the present in-kind replacement value of all vehicles generally stored at this building? ..... \$
7. What is the present in-kind replacement value of all other equipment, supplies, and inventory stored outside of, but in the immediate vicinity of this building? ..... \$
8. What is the present in-kind replacement value of landscaping, access roads, and parking areas associated with this building? ..... \$
- 

9. First Floor Elevation (NGVD) ..... Feet
10. Zero Damage Elevation ..... Feet

11. Please indicated the approximate present dollar value of damage that would be incurred from flooding at each of the listed elevations.

TYPE OF DAMAGE	WATER ELEVATION				
	1 FOOT ABOVE 1ST FLOOR	4 FEET ABOVE 1ST FLOOR	8 FEET ABOVE 1ST FLOOR	12 FEET ABOVE 1ST FLOOR	1972 FLOOD (AGNES) RECURRENCE
STRUCTURE DAMAGE					
CONTENT DAMAGE					
VEHICLE AND OUTSIDE PROPERTY					
EMERGENCY AND CLEAN UP COSTS					
ELEVATION OF FLOOD OF RECORD					

Structure Damage = Damage to any building components, including foundation, walls, floors, doors, windows, roof, electrical system, heating and cooling systems, plumbing, attached carpeting, attached shelves and cabinet, and built-in equipment and appliances.

Content Damage = Damage to unattached equipment, supplies, raw materials, and inventory.

Vehicles and Outside Property Damage = Damage to vehicles parked on the premises; damage to inventory, materials, and equipment kept outside; and damage to signs, landscaping, and parking areas.

Emergency and Clean Up Costs = Costs of moving contents prior to and after flooding to avoid damage, costs of flood fighting, and costs of labor and materials to clean up interior and outside of building.

# **APPENDIX B**

## **BASIC ANALYSES**

## TABLE OF CONTENTS

TABLE B-1	DISTRIBUTION OF THREE-DIGIT LEVEL STANDARD INDUSTRIAL CODES (SIC) .....	B-1
TABLE B-2	CORRELATION MATRIX .....	B-5
TABLE B-3	CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC .....	B-9
TABLE B-4	COMPOSITION OF TOTAL CONTENT VALUE BY SIC .....	B-18



**TABLE B-1****DISTRIBUTION OF THREE-DIGIT LEVEL STANDARD INDUSTRIAL CODES (SIC)**

<b>SIC</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Frequency</b>	<b>Cumulative Percent</b>
17	1	0.2	1	0.2
78	1	0.2	2	0.5
152	2	0.5	4	0.9
162	1	0.2	5	1.1
171	2	0.5	7	1.6
173	1	0.2	8	1.8
177	1	0.2	9	2.0
205	2	0.5	11	2.5
208	2	0.5	13	2.9
224	2	0.5	15	3.4
227	1	0.2	16	3.6
228	1	0.2	17	3.8
233	1	0.2	18	4.1
238	2	0.5	20	4.5
239	3	0.7	23	5.2
243	2	0.5	25	5.6
249	1	0.2	26	5.9
262	1	0.2	27	6.1
273	1	0.2	28	6.3
274	3	0.7	31	7.0
275	2	0.5	33	7.4
279	1	0.2	34	7.7
283	1	0.2	35	7.9
308	1	0.2	36	8.1
328	1	0.2	37	8.4
332	1	0.2	38	8.6
339	1	0.2	39	8.8
349	1	0.2	40	9.0
369	3	0.7	43	9.7
382	1	0.2	44	9.9
384	1	0.2	45	10.2
401	1	0.2	46	10.4
414	1	0.2	47	10.6
422	1	0.2	48	10.8
431	2	0.5	50	11.3
478	1	0.2	51	11.5
481	1	0.2	52	11.7

**TABLE B-1 (Continued)****DISTRIBUTION OF THREE-DIGIT LEVEL STANDARD INDUSTRIAL CODES (SIC)**

<b>SIC</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Frequency</b>	<b>Cumulative Percent</b>
483	2	0.5	54	12.2
491	2	0.5	56	12.6
494	1	0.2	57	12.9
495	1	0.2	58	13.1
504	1	0.2	59	13.3
506	3	0.7	62	14.0
507	2	0.5	64	14.4
508	1	0.2	65	14.7
509	5	1.1	70	15.8
514	6	1.4	76	17.2
519	1	0.2	77	17.4
521	3	0.7	80	18.1
523	1	0.2	81	18.3
525	1	0.2	82	18.5
531	4	0.9	86	19.4
533	1	0.2	87	19.6
541	17	3.8	104	23.5
542	2	0.5	106	23.9
543	1	0.2	107	24.2
544	4	0.9	111	25.1
545	2	0.5	113	25.5
546	5	1.1	118	26.6
549	1	0.2	119	26.9
551	5	1.1	124	28.0
552	11	2.5	135	30.5
553	6	1.4	141	31.8
554	10	2.3	151	34.1
556	2	0.5	153	34.5
559	1	0.2	154	34.8
561	4	0.9	158	35.7
562	2	0.5	160	36.1
563	3	0.7	163	36.8
565	1	0.2	164	37.0
566	3	0.7	167	37.7
569	4	0.9	171	38.6
571	11	2.5	182	41.1
572	3	0.7	185	41.8

**TABLE B-1 (Continued)****DISTRIBUTION OF THREE-DIGIT LEVEL STANDARD INDUSTRIAL CODES (SIC)**

<b>SIC</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Frequency</b>	<b>Cumulative Percent</b>
573	7	1.6	192	43.3
574	1	0.2	193	43.6
581	37	8.4	230	51.9
591	3	0.7	233	52.6
592	1	0.2	234	52.8
594	14	3.2	248	56.0
599	19	4.3	267	60.3
601	7	1.6	274	61.9
606	1	0.2	275	62.1
611	1	0.2	276	62.3
616	2	0.5	278	62.8
631	1	0.2	279	63.0
641	8	1.8	287	64.8
651	4	0.9	291	65.7
655	1	0.2	292	65.9
679	1	0.2	293	66.1
721	4	0.9	297	67.0
722	4	0.9	301	67.9
723	9	2.0	310	70.0
724	1	0.2	311	70.2
725	2	0.5	313	70.7
726	7	1.6	320	72.2
729	1	0.2	321	72.5
733	1	0.2	322	72.7
735	1	0.2	323	72.9
736	1	0.2	324	73.1
737	1	0.2	325	73.4
738	1	0.2	326	73.6
751	3	0.7	329	74.3
753	19	4.3	348	78.6
754	1	0.2	349	78.8
762	2	0.5	351	79.2
769	1	0.2	352	79.5
791	1	0.2	353	79.7
792	1	0.2	354	79.9
793	1	0.2	355	80.1
799	7	1.6	362	81.7

**TABLE B-1 (Continued)****DISTRIBUTION OF THREE-DIGIT LEVEL STANDARD INDUSTRIAL CODES (SIC)**

<b>SIC</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Frequency</b>	<b>Cumulative Percent</b>
801	10	2.3	372	84.0
802	1	0.2	373	84.2
804	1	0.2	374	84.4
805	1	0.2	375	84.7
806	1	0.2	376	84.9
807	1	0.2	377	85.1
809	3	0.7	380	85.8
811	2	0.5	382	86.2
821	11	2.5	393	88.7
823	3	0.7	396	89.4
832	2	0.5	398	89.8
835	2	0.5	400	90.3
841	1	0.2	401	90.5
863	1	0.2	402	90.7
864	1	0.2	403	91.0
866	23	5.2	426	96.2
869	1	0.2	427	96.4
871	4	0.9	431	97.3
872	2	0.5	433	97.7
899	1	0.2	434	98.0
911	2	0.5	436	98.4
922	5	1.1	441	99.5
951	1	0.2	442	99.8
953	1	0.2	443	100.0

Frequency Missing = 6

## VARIABLES IN CORRELATION MATRIX (TABLE B-2)

WATEREL	Depth of flood relative to first floor
BASEMENT	Categorical variable indicating existence of basement (1 = yes/0 = no)
NOBUILD2	Number of buildings at location
SQFT2	Building area in square feet
NOEMPLO	Number of personnel employed at the location
STORY2	Number of floors in the structure
REPVALU	Depreciated structure replacement value
BASEF	Average area per floor ( $=SQFT2/STORY2$ )
CONTENT	Total building content value
DAYSCL0	Number of days business was closed due to flooding
INVENT2	Total in kind replacement value of business inventory in that structure
BUSREC2	Total in kind replacement value of equipment and supplies not physically attached
VEHIC2	Replacement value of vehicles kept in that structure
EXTER2	Total replacement value of equipment and inventory kept in vicinity
LAND2	Total replacement value of landscaping, access roads, and parking areas
FLOODIN	Categorical variable indicating flood insurance purchase (1 = yes/0 = no)
YEARS	Number of years in business at that location
FLOODED	Categorical variable indicating flood damage from Tropical Storm Agnes (1 = yes/0 = no)

**TABLE B-2**  
**CORRELATION MATRIX**

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	BASEMENT	YEARS	FLOODED	NOBUILD2	SQFT2	NOEMPLO	STORY2	REPVALU
BASEMENT	1.00000 0.0 408	0.27091 0.0001 388	0.16382 0.0010 400	0.07888 0.1134 404	-0.00333 0.9467 406	0.05893 0.2481 386	0.39578 0.0001 406	0.04688 0.3449 408
YEARS	0.27091 0.0001 388	1.00000 0.0 425	0.29517 0.0001 417	0.22061 0.0001 421	0.14198 0.0034 423	0.01066 0.8311 403	0.23699 0.0001 419	0.08616 0.0760 425
FLOODED	0.16382 0.0010 400	0.29517 0.0001 417	1.00000 0.0 440	0.14746 0.0020 436	0.11678 0.0146 437	0.06215 0.2064 415	0.10450 0.0295 434	0.10752 0.0241 440
NOBUILD2	0.07888 0.1134 404	0.22061 0.0001 421	0.14746 0.0020 436	1.00000 0.0 445	0.22242 0.0001 442	0.07557 0.1220 420	0.02486 0.6039 438	0.19254 0.0001 445
SQFT2	-0.00333 0.9467 406	0.14198 0.0034 423	0.11678 0.0146 437	0.22242 0.0001 442	1.00000 0.0 446	0.24558 0.0001 421	0.12211 0.0104 439	0.70798 0.0001 446
NOEMPLO	0.05893 0.2481 386	0.01066 0.8311 403	0.06215 0.2064 415	0.07557 0.1220 420	0.24558 0.0001 421	1.00000 0.0 424	0.32940 0.0001 417	0.39680 0.0001 424
STORY2	0.39578 0.0001 406	0.23699 0.0001 419	0.10450 0.0295 434	0.02486 0.6039 438	0.12211 0.0104 439	0.32940 0.0001 417	1.00000 0.0 442	0.25698 0.0001 442
REPVALU	0.04688 0.3449 408	0.08616 0.0760 425	0.10752 0.0241 440	0.19254 0.0001 445	0.70798 0.0001 446	0.39680 0.0001 424	0.25698 0.0001 442	1.00000 0.0 449
CONTENT	-0.02995 0.5716 359	-0.01009 0.8452 377	0.07163 0.1580 390	0.08163 0.1061 393	0.27342 0.0001 394	0.19259 0.0002 374	0.02280 0.6527 392	0.30698 0.0001 397
INVENT2	-0.04011 0.4604 341	-0.00380 0.9432 355	0.04903 0.3489 367	0.05672 0.2752 372	0.16068 0.0018 374	0.09779 0.0653 356	-0.02988 0.5662 371	0.10739 0.0374 376
BUSREC2	0.09036 0.1322 279	0.03262 0.5742 299	0.11034 0.0542 305	0.26631 0.0001 304	0.14189 0.0133 304	0.23324 0.0001 295	0.18548 0.0012 303	0.20296 0.0003 307
EQVAL2	0.02666 0.5941 402	0.04774 0.3290 420	0.07862 0.1019 434	0.13119 0.0059 439	0.29712 0.0001 440	0.31660 0.0001 418	0.07953 0.0972 436	0.44974 0.0001 443
VEHIC2	-0.08024 0.2563 202	0.08897 0.1866 222	0.09007 0.1753 228	0.12462 0.0609 227	0.12699 0.0566 226	0.13987 0.0395 217	-0.05657 0.3974 226	0.04822 0.4688 228
EXTER2	0.02690 0.7833 107	0.15108 0.1151 110	0.00620 0.9483 112	-0.06320 0.5041 114	0.00384 0.9676 114	0.22191 0.0210 108	-0.11602 0.2211 113	0.03489 0.7112 115

**TABLE B-2 (Continued)**  
**CORRELATION MATRIX**

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	<b>BASEMENT</b>	<b>YEARS</b>	<b>FLOODED</b>	<b>NOBUILD2</b>	<b>SQFT2</b>	<b>NOEMPLO</b>	<b>STORY2</b>	<b>REPVALU</b>
LAND2	0.03695 0.5381 280	0.10704 0.0673 293	0.05886 0.3088 301	0.12177 0.0341 303	0.22946 0.0001 303	0.00016 0.9979 291	-0.05030 0.3845 301	0.21812 0.0001 306
FLOODIN	0.02646 0.5978 400	0.06065 0.2170 416	0.04651 0.3365 429	0.02414 0.6160 434	0.12370 0.0098 435	0.08985 0.0678 414	0.07539 0.1181 431	0.08823 0.0651 438
BASEMENT	-0.02995 0.5716 359	-0.04011 0.4604 341	0.09036 0.1322 279	0.02666 0.5941 402	-0.08024 0.2563 202	0.02690 0.7833 107	0.03695 0.5381 280	0.02646 0.5978 400
YEARS	-0.01009 0.8452 377	-0.00380 0.9432 355	0.03262 0.5742 299	0.04774 0.3290 420	0.08897 0.1866 222	0.15108 0.1151 110	0.10704 0.0673 293	0.06065 0.2170 416
FLOODED	0.07163 0.1580 390	0.04903 0.3489 367	0.11034 0.0542 305	0.07862 0.1019 434	0.09007 0.1753 228	0.00620 0.9483 112	0.05886 0.3088 301	0.04651 0.3365 429
NOBUILD2	0.08163 0.1061 393	0.05672 0.2752 372	0.26631 0.0001 304	0.13119 0.0059 439	0.12462 0.0609 227	-0.06320 0.5041 114	0.12177 0.0341 303	0.02414 0.6160 434
SQFT2	0.27342 0.0001 394	0.16068 0.0018 374	0.14189 0.0133 304	0.29712 0.0001 440	0.12699 0.0566 226	0.00384 0.9676 114	0.22946 0.0001 303	0.12370 0.0098 435
NOEMPLO	0.19259 0.0002 374	0.09779 0.0653 356	0.23324 0.0001 295	0.31660 0.0001 418	0.13987 0.0395 217	0.22191 0.0210 108	0.00016 0.9979 291	0.08985 0.0678 414
STORY2	0.02280 0.6527 392	-0.02988 0.5662 371	0.18548 0.0012 303	0.07953 0.0972 436	-0.05657 0.3974 226	-0.11602 0.2211 113	-0.05030 0.3845 301	0.07539 0.1181 431
REPVALU	0.30698 0.0001 397	0.10739 0.0374 376	0.20296 0.0003 307	0.44974 0.0001 443	0.04822 0.4688 228	0.03489 0.7112 115	0.21812 0.0001 306	0.08823 0.0651 438
CONTENT	1.00000 0.0 397	0.93488 0.0001 348	0.18106 0.0020 290	0.41042 0.0001 393	0.04208 0.5432 211	0.28924 0.0041 97	0.29485 0.0001 271	0.06912 0.1742 388
INVENT2	0.93488 0.0001 348	1.00000 0.0 376	0.06975 0.2634 259	0.06743 0.1956 370	0.03227 0.6552 194	0.12352 0.2256 98	0.54251 0.0001 247	0.06052 0.2475 367
BUSREC2	0.18106 0.0020 290	0.06975 0.2634 259	1.00000 0.0 307	0.11881 0.0381 305	0.02204 0.7722 175	0.15208 0.1597 87	0.34155 0.0001 219	0.05038 0.3870 297
EQVAL2	0.41042 0.0001 393	0.06743 0.1956 370	0.11881 0.0381 305	1.00000 0.0 443	0.02322 0.7290 225	0.21514 0.0209 115	0.02185 0.7044 304	0.04210 0.3828 432

**TABLE B-2 (Continued)**  
**CORRELATION MATRIX**

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations

	<b>BASEMENT</b>	<b>YEARS</b>	<b>FLOODED</b>	<b>NOBUILD2</b>	<b>SQFT2</b>	<b>NOEMPLO</b>	<b>STORY2</b>	<b>REPVALU</b>
VEHIC2	0.04208 0.5432 211	0.03227 0.6552 194	0.02204 0.7722 175	0.02322 0.7290 225	1.00000 0.0 228	-0.04296 0.7144 75	-0.02059 0.7942 163	0.12766 0.0576 222
EXTER2	0.28924 0.0041 97	0.12352 0.2256 98	0.15208 0.1597 87	0.21514 0.0209 115	-0.04296 0.7144 75	1.00000 0.0 115	0.04775 0.6405 98	0.04150 0.6611 114
LAND2	0.29485 0.0001 271	0.54251 0.0001 247	0.34155 0.0001 219	0.02185 0.7044 304	-0.02059 0.7942 163	0.04775 0.6405 98	1.00000 0.0 306	0.05565 0.3335 304
FLOODIN	0.06912 0.1742 388	0.06052 0.2475 367	0.05038 0.3870 297	0.04210 0.3828 432	0.12766 0.0576 222	0.04150 0.6611 114	0.05565 0.3335 304	1.00000 0.0 438

TABLE B-3

## CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
-	5	0.1493	1.524	0.724	0.548	5	0.1067	1.524	0.708	0.559
17	1	1.2010	1.201	1.201	-	1	0.9922	0.992	0.992	-
78	1	8.3472	8.347	8.347	-	1	7.2873	7.287	7.287	-
152	2	0.0542	0.807	0.430	0.532	2	0.0482	0.766	0.407	0.508
162	1	0.3239	0.324	0.324	-	1	0.2591	0.259	0.259	-
171	2	0.8523	0.866	0.859	0.010	2	0.5849	0.674	0.629	0.063
173	1	1.0215	1.021	1.021	-	1	0.8512	0.851	0.851	-
177	1	3.9776	3.978	3.978	-	1	3.9776	3.978	3.978	-
205	1	0.4382	0.438	0.438	-	1	0.2191	0.219	0.219	-
208	2	0.6441	2.415	1.530	1.252	2	0.6039	1.779	1.192	0.831
224	2	1.7657	351.453	176.609	247.266	2	1.7422	350.032	175.887	246.278
227	1	0.1963	0.196	0.196	-	1	0.1963	0.196	0.196	-
228	1	0.7646	0.765	0.765	-	1	0.7646	0.765	0.765	-
233	1	0.9788	0.979	0.979	-	1	0.9788	0.979	0.979	-
238	2	4.0040	56.379	30.191	37.035	2	3.8844	56.320	30.102	37.077
239	3	0.8892	1.900	1.492	0.533	3	0.8862	1.893	1.462	0.519

TABLE B-3 (Continued)

CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
243	2	1.3198	1.528	1.424	0.147	2	1.2670	1.386	1.326	0.084
249	1	0.1280	0.128	0.128	-	1	0.1280	0.128	0.128	-
262	1	50.6546	50.655	50.655	-	1	50.6546	50.655	50.655	-
273	1	1.5838	1.584	1.584	-	1	0.4525	0.453	0.453	-
274	3	1.6715	4.938	2.936	1.754	3	1.4019	4.232	2.546	1.491
275	2	0.7683	4.250	2.509	2.462	2	0.6609	3.719	2.190	2.162
279	1	6.0267	6.027	6.027	-	1	5.4138	5.414	5.414	-
283	1	9.6628	9.663	9.663	-	1	9.6628	9.663	9.663	-
308	1	3.3194	3.319	3.319	-	1	3.3194	3.319	3.319	-
328	1	1.9792	1.979	1.979	-	1	1.9467	1.947	1.947	-
332	0	-	-	-	-	0	-	-	-	-
339	1	6.8959	6.896	6.896	-	1	2.2986	2.299	2.299	-
349	1	17.5829	17.583	17.583	-	1	12.5592	12.559	12.559	-
369	3	0.7526	1.929	1.396	0.596	3	0.7298	1.890	1.364	0.588
382	1	20.3389	20.339	20.339	-	1	19.1425	19.143	19.143	-
384	1	15.1204	15.120	15.120	-	1	4.4722	4.472	4.472	-

**TABLE B-3 (Continued)**

**CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC**

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
401	1	0.3541	0.354	0.354	-	1	0.2833	0.283	0.283	-
414	1	0.6810	0.681	0.681	-	1	0.6416	0.642	0.642	-
422	1	4.1561	4.156	4.156	-	1	4.1426	4.143	4.143	-
431	2	0.1568	0.710	0.433	0.391	2	0.1568	0.634	0.395	0.337
478	1	0.1930	0.193	0.193	-	1	0.1688	0.169	0.169	-
481	1	1.5324	1.532	1.532	-	1	1.3281	1.328	1.328	-
483	2	0.9081	2.227	1.567	0.932	2	0.5010	2.213	1.357	1.210
491	1	12.8617	12.862	12.862	-	1	12.8617	12.862	12.862	-
494	1	0.9548	0.955	0.955	-	1	0.9548	0.955	0.955	-
495	1	0.50896	0.5090	0.50896	-	1	0.50896	0.5090	0.50896	-
504	1	2.06556	2.0656	2.06556	-	1	1.45804	1.4580	1.45804	-
506	3	0.69033	1.1081	0.83261	0.23866	3	0.51775	1.0118	0.73990	0.25074
507	2	0.80720	6.4270	3.61709	3.97378	2	0.79253	6.1209	3.45673	3.76775
508	1	0.15955	0.1596	0.15955	-	1	0.14319	0.1432	0.14319	-
509	5	0.96674	2.5731	1.80334	0.63207	5	0.96674	2.5662	1.53298	0.62330
514	6	0.40977	1.6797	1.06465	0.52960	6	0.34806	1.4297	0.89444	0.45787

TABLE B-3 (Continued)

## CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
519	1	0.80405	0.8041	0.80405	-	1	0.66047	0.6605	0.66047	-
521	3	0.18452	1.2380	0.73023	0.52776	3	0.18452	1.2347	0.72913	0.52618
523	1	3.06995	3.0699	3.06995	-	1	2.59765	2.5976	2.59765	-
525	1	0.74624	0.7462	0.74624	-	1	0.73703	0.7370	0.73703	-
531	4	0.43104	1.5715	1.21311	0.53401	4	0.42306	1.5290	1.18145	0.51853
533	1	0.58668	0.5867	0.58668	-	1	0.58668	0.5867	0.58668	-
541	14	0.12968	6.7879	2.01379	1.58215	14	0.12267	3.0500	1.68231	0.93514
542	1	0.69855	0.6985	0.69855	-	1	0.68097	0.6810	0.68097	-
543	1	0.45642	0.4564	0.45642	-	1	0.36513	0.3651	0.36513	-
544	4	0.79411	8.8984	3.04199	3.91913	4	0.65310	8.8841	2.80537	4.05364
545	1	0.83980	0.8398	0.83980	-	1	0.83980	0.8398	0.83980	-
546	5	0.22886	3.3258	1.72062	1.24989	5	0.22886	3.3207	1.71177	1.24714
549	1	0.46775	0.4678	0.46775	-	1	0.46775	0.4678	0.46775	-
551	3	0.38843	2.9800	1.36582	1.40825	3	0.38843	2.5543	1.22391	1.16465
552	10	0.05643	2.7895	0.83440	0.94514	10	0.03527	2.7246	0.53896	0.78521
553	6	0.39841	1.2230	0.86229	0.29504	6	0.39316	1.1118	0.80107	0.25752

TABLE B-3 (Continued)

## CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
554	10	0.15991	10.1920	1.88472	3.03591	10	0.15991	10.0949	1.82605	3.02737
556	2	0.57756	1.5944	1.08600	0.71904	2	0.50825	1.5944	1.05135	0.76805
559	1	4.94369	4.9437	4.94369	-	1	4.86584	4.8658	4.86584	-
561	4	0.81893	5.0601	3.05109	2.08818	4	0.70194	4.6638	2.80583	1.89091
562	1	1.93821	1.9382	1.93821	-	1	0.76354	0.7635	0.76354	-
563	3	0.30000	2.0367	1.25242	0.88049	3	0.22000	1.9710	1.19853	0.89352
565	1	0.24614	0.2461	0.24614	-	1	0.24510	0.2451	0.24510	-
566	3	1.18207	3.5457	2.05034	1.30061	3	1.18207	3.5194	1.97746	1.33556
569	4	0.93561	1.8041	1.36936	0.38012	4	0.92122	1.7988	1.31869	0.36675
571	10	0.27960	2.9745	1.25415	1.15157	10	0.25508	2.8093	0.94620	0.89701
572	3	0.49636	1.1052	0.72925	0.32870	3	0.43431	1.1052	0.70725	0.35251
573	7	0.09375	18.3365	3.30064	6.65355	7	0.08672	17.4197	3.06860	6.34392
574	1	4.76535	4.7653	4.76535	-	1	4.74636	4.7464	4.74636	-
581	34	0.03586	1.1712	0.50394	0.32692	34	0.03356	1.1244	0.48593	0.32135
591	3	0.74395	1.0551	0.92776	0.16307	3	0.44235	0.9561	0.77389	0.28759
592	1	0.79780	0.7978	0.79780	-	1	0.78949	0.7895	0.78949	-

TABLE B-3 (Continued)

## CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
594	12	0.02169	9.3804	2.49866	2.47106	12	0.01972	8.7198	2.03580	2.30318
599	18	0.16657	5.3914	1.28769	1.26059	18	0.16657	5.3914	1.21794	1.25618
601	3	0.08184	0.39230	0.20918	0.16258	3	0.08184	0.39230	0.20918	0.16258
606	1	0.65089	0.65089	0.65089	-	1	0.58164	0.58164	0.58164	-
611	1	0.39992	0.39992	0.39992	-	1	0.33839	0.33839	0.33839	-
616	1	0.15935	0.15935	0.15935	-	1	0.10623	0.10623	0.10623	-
631	0	-	-	-	-	0	-	-	-	-
641	6	0.19843	0.99568	0.61652	0.30610	6	0.18039	0.43640	0.34459	0.09335
655	1	0.47949	0.47949	0.47949	-	1	0.39729	0.39729	0.39729	0.25741
679	1	0.63508	0.63508	0.63508	-	1	0.53981	0.53981	0.53981	-
721	4	0.34717	9.58894	4.64843	4.86873	4	0.23145	9.58894	4.61135	4.91199
722	3	1.13101	4.81464	3.45835	2.02472	3	0.94251	4.43453	3.26882	2.01464
723	9	0.06770	0.96967	0.47523	0.32166	9	0.06637	0.88886	0.41312	0.29299
724	1	0.83684	0.83684	0.83684	-	1	0.83684	0.83684	0.83684	-
725	2	0.77073	3.71662	2.24367	2.08306	2	0.77073	3.71662	2.24367	2.08306
726	7	0.17755	2.63317	0.83173	0.95740	7	0.17755	2.63317	0.83173	0.95740

TABLE B-3 (Continued)

## CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
729	1	1.38189	1.38189	1.38189	-	1	0.63492	0.63492	0.63492	-
733	1	1.16244	1.16244	1.16244	-	1	1.15420	1.15420	1.15420	-
735	1	4.48852	4.48852	4.48852	-	1	4.22449	4.22449	4.22449	-
736	0	-	-	-	-	0	-	-	-	-
737	1	3.92491	3.92491	3.92491	-	1	1.12140	1.12140	1.12140	-
738	1	1.30936	1.30936	1.30936	-	1	1.26571	1.26571	1.26571	-
751	2	1.53374	1.58530	1.55952	0.03646	2	1.27812	1.48622	1.38217	0.14715
753	17	0.10641	4.18699	1.20842	1.14323	17	0.06841	4.18699	1.13178	1.08840
754	1	0.92096	0.92096	0.92096	-	1	0.92096	0.92096	0.92096	-
762	2	0.20365	1.39330	0.79848	0.84121	2	0.13577	0.39809	0.26693	0.18549
769	1	1.53161	1.53161	1.53161	-	1	1.18351	1.18351	1.18351	-
791	1	0.13423	0.13423	0.13423	-	1	10.13046	0.13046	0.13046	-
792	1	0.84297	0.84297	0.84297	-	1	0.72254	0.72254	0.72254	-
793	1	1.21833	1.21833	1.21833	-	1	1.21639	1.21639	1.21639	-
799	6	0.09445	1.08869	0.38701	0.37000	6	0.09370	1.08869	0.34736	0.37660
801	8	0.25922	1.21325	0.83643	0.32414	8	0.20162	1.11887	0.69643	0.27597

TABLE B-3 (Continued)

CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
802	1	0.80099	0.80099	0.80099	-	1	0.56845	0.56845	0.56845	-
804	1	1.35631	1.35631	1.35631	-	1	0.68487	0.68487	0.68487	-
805	1	0.60202	0.60202	0.60202	-	1	0.56948	0.56948	0.56948	-
806	1	0.97527	0.97527	0.97527	-	1	0.97527	0.97527	0.97527	-
807	1	0.25844	0.25844	0.25844	-	1	0.25214	0.25214	0.25214	-
809	3	0.56494	1.99947	1.06837	0.80724	3	0.32560	0.88865	0.59306	0.28258
811	1	0.24010	0.24010	0.24010	-	1	0.18470	0.18470	0.18470	-
821	9	0.11119	2.68121	0.52446	0.81412	9	0.10901	2.57809	0.46354	0.79606
823	2	1.73024	2.32678	2.02851	0.42182	2	1.70091	2.32106	2.01099	0.43851
832	1	0.50929	0.50929	0.50929	-	1	0.35771	0.35771	0.35771	-
835	2	0.12081	0.14431	0.13256	0.01661	2	0.10810	0.13775	0.12292	0.02097
841	1	6.06384	6.06384	6.06384	-	1	6.03352	6.03352	6.03352	-
863	1	0.60821	0.60821	0.60821	-	1	0.29489	0.29489	0.29489	-
864	0	-	-	-	-	0	-	-	-	-
866	16	0.04394	1.63713	0.40576	0.40298	16	0.04394	0.99004	0.34035	0.27932
869	1	0.59978	0.59978	0.59978	-	1	0.38874	0.38874	0.38874	-

**TABLE B-3 (Continued)**

**CONTENT VALUE TO STRUCTURE VALUE RATIOS BY SIC**

SIC	Content to Total Depreciated Replacement Value					Content to Total Depreciated Replacement Value Without Business Records				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
871	4	0.49964	1.45068	0.83734	0.44497	4	0.25885	0.72069	0.49416	0.21559
872	2	0.51542	1.86475	1.19008	0.95412	2	0.24415	0.40791	0.32603	0.11580
899	1	0.82672	0.82672	0.82672	-	1	0.82517	0.82517	0.82517	-
911	2	0.11689	0.18809	0.15249	0.05035	2	0.04024	0.18288	0.11156	0.10086
922	4	0.61589	3.33458	1.76346	1.13884	4	0.47591	1.89726	1.36914	0.62162
951	1	1.88527	1.88527	1.88527	-	1	0.53865	0.53865	0.53865	-
953	1	1.15545	1.15545	1.15545	-	1	1.11888	1.11888	1.11888	-

TABLE B-4

## COMPOSITION OF TOTAL CONTENT VALUE BY SIC

SIC	FRACTION OF TOTAL CONTENT VALUE IN INTERIOR EQUIPMENT					FRACTION OF TOTAL CONTENT VALUE IN BUSINESS RECORDS					FRACTION OF TOTAL CONTENT VALUE IN INVENTORY				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
	5	0.00498	0.95789	0.40152	0.37268	5	0.00000	0.28571	0.06924	0.12224	5	0.00000	0.99502	0.52923	0.43338
17	1	0.69565	0.69565	0.69565	-	1	0.17391	0.17391	0.17391	-	1	0.13043	0.13043	0.13043	-
78	1	0.63492	0.63492	0.63492	-	1	0.12698	0.12698	0.12698	-	1	0.23810	0.23810	0.23810	-
152	2	0.66000	0.66667	0.66333	0.00471	2	0.05000	0.11111	0.08056	0.04321	2	0.12000	0.22222	0.17111	0.07228
162	1	0.80000	0.80000	0.80000	-	1	0.20000	0.20000	0.20000	-	1	0.00000	0.00000	0.00000	-
171	2	0.49020	0.55556	0.52288	0.04622	2	0.22222	0.31373	0.26797	0.06470	2	0.19608	0.22222	0.20915	0.01849
173	1	0.83333	0.83333	0.83333	-	1	0.16667	0.16667	0.16667	-	1	0.00000	0.00000	0.00000	-
177	1	0.00000	0.00000	0.00000	-	1	0.00000	0.00000	0.00000	-	1	1.00000	1.00000	1.00000	-
205	1	0.40000	0.40000	0.40000	-	1	0.50000	0.50000	0.50000	-	1	0.10000	0.10000	0.10000	-
208	2	0.50000	0.52632	0.51316	0.01861	2	0.06250	0.26316	0.16283	0.14189	2	0.21053	0.43750	0.32401	0.16049
224	2	0.00294	0.66667	0.33481	0.46932	2	0.00404	0.01333	0.00869	0.00657	2	0.32000	0.99301	0.65651	0.47589
227	1	0.57143	0.57143	0.57143	-	1	0.00000	0.00000	0.00000	-	1	0.42857	0.42857	0.42857	-
228	1	0.05263	0.05263	0.05263	-	1	0.00000	0.00000	0.00000	-	1	0.94737	0.94737	0.94737	-
233	1	0.08257	0.08257	0.08257	-	1	0.00000	0.00000	0.00000	-	1	0.91743	0.91743	0.91743	-
238	2	0.44776	0.94637	0.69707	0.35257	2	0.00105	0.02985	0.01545	0.02036	2	0.05258	0.52239	0.28748	0.33221
239	3	0.30750	0.85324	0.50596	0.30178	3	0.00341	0.04762	0.01824	0.02544	3	0.14334	0.68881	0.47580	0.29169
243	2	0.42667	0.56000	0.49333	0.09428	2	0.04000	0.09333	0.06667	0.03771	2	0.36000	0.40000	0.38000	0.02828
249	1	1.00000	1.00000	1.00000	-	1	0.00000	0.00000	0.00000	-	1	0.00000	0.00000	0.00000	-
262	1	0.82353	0.82353	0.82353	-	1	0.00000	0.00000	0.00000	-	1	0.17647	0.17647	0.17647	-
273	1	0.23810	0.23810	0.23810	-	1	0.71429	0.71429	0.71429	-	1	0.04762	0.04762	0.04762	-
274	3	0.42857	0.89286	0.70929	0.24692	3	0.08929	0.16129	0.13114	0.03740	3	0.01786	0.42857	0.15956	0.23308
275	2	0.80645	0.83333	0.81989	0.01901	2	0.12500	0.13978	0.13239	0.01045	2	0.04167	0.05376	0.04772	0.00855
279	1	0.84746	0.84746	0.84746	-	1	0.10169	0.10169	0.10169	-	1	0.05085	0.05085	0.05085	-

TABLE B-4 (Continued)

## COMPOSITION OF TOTAL CONTENT VALUE BY SIC

SIC	FRACTION OF TOTAL CONTENT VALUE IN INTERIOR EQUIPMENT					FRACTION OF TOTAL CONTENT VALUE IN BUSINESS RECORDS					FRACTION OF TOTAL CONTENT VALUE IN INVENTORY				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
283	1	0.75000	0.75000	0.75000	-	1	0.00000	0.00000	0.00000	-	1	0.25000	0.25000	0.25000	-
308	1	0.42857	0.42857	0.42857	-	1	0.00000	0.00000	0.00000	-	1	0.57143	0.57143	0.57143	-
328	1	0.81967	0.81967	0.81967	-	1	0.01639	0.01639	0.01639	-	1	0.16393	0.16393	0.16393	-
332	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
339	1	0.33333	0.33333	0.33333	-	1	0.66667	0.66667	0.66667	-	1	0.00000	0.00000	0.00000	-
349	1	0.57143	0.57143	0.57143	-	1	0.28571	0.28571	0.28571	-	1	0.14286	0.14286	0.14286	-
369	3	0.04018	0.90909	0.60262	0.48774	3	0.02020	0.03030	0.02428	0.00533	3	0.06061	0.93750	0.37311	0.48972
382	1	0.58824	0.58824	0.58824	-	1	0.05882	0.05882	0.05882	-	1	0.35294	0.35294	0.35294	-
384	1	0.01408	0.01408	0.01408	-	1	0.70423	0.70423	0.70423	-	1	0.28169	0.28169	0.28169	-
401	1	0.80000	0.80000	0.80000	-	1	0.20000	0.20000	0.20000	-	1	0.00000	0.00000	0.00000	-
414	1	0.07246	0.07246	0.07246	-	1	0.05797	0.05797	0.05797	-	1	0.86957	0.86957	0.86957	-
422	1	0.01954	0.01954	0.01954	-	1	0.00326	0.00326	0.00326	-	1	0.97720	0.97720	0.97720	-
431	2	0.00000	0.71429	0.35714	0.50508	2	0.00000	0.10714	0.05357	0.07576	2	0.17857	1.00000	0.58929	0.58084
478	1	0.37500	0.37500	0.37500	-	1	0.12500	0.12500	0.12500	-	1	0.50000	0.50000	0.50000	-
481	1	0.13333	0.13333	0.13333	-	1	0.13333	0.13333	0.13333	-	1	0.40000	0.40000	0.40000	-
483	2	0.06211	0.55172	0.30692	0.34621	2	0.00621	0.44828	0.22724	0.31259	2	0.00000	0.93168	0.46584	0.65880
491	1	0.99174	0.99174	0.99174	-	1	0.00000	0.00000	0.00000	-	1	0.00826	0.00826	0.00826	-
494	1	0.98522	0.98522	0.98522	-	1	0.00000	0.00000	0.00000	-	1	0.01478	0.01478	0.01478	-
495	1	1.00000	1.00000	1.00000	-	1	0.00000	0.00000	0.00000	-	1	0.00000	0.00000	0.00000	-
504	1	0.23529	0.23529	0.23529	-	1	0.29412	0.29412	0.29412	-	1	0.47059	0.47059	0.47059	-
506	3	0.12500	0.49342	0.26411	0.20009	3	0.01316	0.25000	0.11670	0.12119	3	0.49342	0.73913	0.61918	0.12296
507	2	0.07273	0.59524	0.33398	0.36947	2	0.01818	0.04762	0.03290	0.02082	2	0.35714	0.90909	0.63312	0.39029
508	1	0.76923	0.76923	0.76923	-	1	0.10256	0.10256	0.10256	-	1	0.12821	0.12821	-	0.12821

TABLE B-4 (Continued)

## COMPOSITION OF TOTAL CONTENT VALUE BY SIC

SIC	FRACTION OF TOTAL CONTENT VALUE IN INTERIOR EQUIPMENT					FRACTION OF TOTAL CONTENT VALUE IN BUSINESS RECORDS					FRACTION OF TOTAL CONTENT VALUE IN INVENTORY				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
509	5	0.03846	0.36667	0.17461	0.15735	5	0.00000	0.48077	0.12884	0.20437	5	0.13333	0.89744	0.57708	0.30652
514	6	0.15789	0.86207	0.48648	0.27504	6	0.00901	0.49123	0.14323	0.18647	6	0.01961	0.63063	0.37029	0.25542
519	1	0.25000	0.25000	0.25000	-	1	0.17857	0.17857	0.17857	-	1	0.57143	0.57143	0.57143	-
521	3	0.05263	1.00000	0.48386	0.47936	3	0.00000	0.00266	0.00089	0.00154	3	0.00000	0.94737	0.51526	0.47913
523	1	0.07692	0.07692	0.07692	-	1	0.15385	0.15385	0.15385	-	1	0.76923	0.76923	0.76923	-
525	1	0.12346	0.12346	0.12346	-	1	0.01235	0.01235	0.01235	-	1	0.86420	0.86420	0.86420	-
531	4	0.07784	0.27027	0.15501	0.08915	4	0.01853	0.03000	0.02488	0.00490	4	0.54000	0.89820	0.75761	0.17082
533	1	0.41667	0.41667	0.41667	-	1	0.00000	0.00000	0.00000	-	1	0.58333	0.58333	0.58333	-
541	14	0.20000	0.92696	0.62662	0.17949	14	0.00000	0.75000	0.09808	0.23930	14	0.05000	0.42857	0.27530	0.12012
542	1	0.78616	0.78616	0.78616	-	1	0.02516	0.02516	0.02516	-	1	0.18868	0.18868	0.18868	-
543	1	0.40000	0.40000	0.40000	-	1	0.20000	0.20000	0.20000	-	1	0.40000	0.40000	0.40000	-
544	4	0.03221	0.50000	0.27276	0.21214	4	0.00000	0.58333	0.15114	0.28827	4	0.25000	0.96618	0.57610	0.29690
545	1	0.70000	0.70000	0.70000	-	1	0.00000	0.00000	0.00000	-	1	0.06000	0.06000	0.06000	-
546	5	0.56250	0.98361	0.85265	0.16715	5	0.00000	0.02083	0.00447	0.00917	5	0.01639	0.41667	0.14287	0.15828
549	1	0.71429	0.71429	0.71429	-	1	0.00000	0.00000	0.00000	-	1	0.28571	0.28571	0.28571	-
551	3	0.33333	0.66667	0.52381	0.17169	3	0.00000	0.14286	0.04762	0.08248	3	0.20000	0.66667	0.38413	0.24841
552	10	0.04651	0.94340	0.45373	0.27906	10	0.02326	0.78125	0.33738	0.27998	10	0.00000	0.93023	0.13140	0.29227
553	6	0.22727	0.68966	0.46759	0.20006	6	0.01316	0.10000	0.06325	0.03945	6	0.28571	0.68182	0.41439	0.16185
554	10	0.02857	1.00000	0.56492	0.32764	10	0.00000	0.22727	0.08852	0.10281	10	0.00000	0.71429	0.32181	0.23290
556	2	0.08000	0.95238	0.51619	0.61687	2	0.00000	0.12000	0.06000	0.08485	2	0.04762	0.80000	0.42381	0.53201
559	1	0.68898	0.68898	0.68898	-	1	0.01575	0.01575	0.01575	-	1	0.29528	0.29528	0.29528	-
561	4	0.00783	0.28571	0.15077	0.11395	4	0.00000	0.14286	0.08081	0.06010	4	0.61224	0.91384	0.76843	0.13252
562	1	0.09091	0.09091	0.09091	-	1	0.60606	0.60606	0.60606	-	1	0.30303	0.30303	0.30303	-

TABLE B-4 (Continued)

## COMPOSITION OF TOTAL CONTENT VALUE BY SIC

SIC	FRACTION OF TOTAL CONTENT VALUE IN INTERIOR EQUIPMENT					FRACTION OF TOTAL CONTENT VALUE IN BUSINESS RECORDS					FRACTION OF TOTAL CONTENT VALUE IN INVENTORY				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
563	3	0.06667	0.32258	0.16720	0.13649	3	0.01124	0.26667	0.10339	0.14179	3	0.64516	0.87640	0.72941	0.12775
565	1	0.59322	0.59322	0.59322	-	1	0.00424	0.00424	0.00424	-	1	0.40254	0.40254	0.40254	-
566	3	0.05405	0.16667	0.12614	0.06239	3	0.00000	0.13514	0.04752	0.07597	3	0.81081	0.83488	0.82634	0.01347
569	4	0.04762	0.75000	0.31634	0.33330	4	0.00000	0.11905	0.03435	0.05686	4	0.25000	0.92308	0.64931	0.30093
571	10	0.01186	0.42857	0.14537	0.15541	10	0.01345	0.79051	0.13593	0.23624	10	0.19763	0.95238	0.66922	0.27397
572	3	0.15152	0.50000	0.30051	0.17965	3	0.00000	0.12500	0.04391	0.07031	3	0.50000	0.84175	0.65558	0.17292
573	7	0.00000	0.80000	0.32704	0.28066	7	0.00000	0.29630	0.11638	0.11328	7	0.20000	0.66667	0.49825	0.18094
574	1	0.49801	0.49801	0.49801	-	1	0.00398	0.00398	0.00398	-	1	0.49801	0.49801	0.49801	-
581	34	0.17647	0.96774	0.76399	0.18618	34	0.00000	0.26667	0.04399	0.06031	34	0.02703	0.40000	0.13626	0.11243
591	3	0.05405	0.62500	0.32159	0.28716	3	0.02857	0.40541	0.18633	0.19576	3	0.25000	0.68571	0.49208	0.22186
592	1	0.05208	0.05208	0.05208	-	1	0.01042	0.01042	0.01042	-	1	0.93750	0.93750	0.93750	-
594	12	0.00000	0.42857	0.20763	0.13469	12	0.00000	0.95420	0.12674	0.26646	12	0.03817	0.84507	0.64641	0.21291
599	18	0.06849	0.96339	0.50882	0.25282	18	0.00000	0.28571	0.06982	0.08804	18	0.03661	0.89041	0.37043	0.28160
601	3	0.96774	1.00000	0.98378	0.01613	3	0.00000	0.00000	0.00000	0.00000	3	0.00000	0.03226	0.01622	0.01613
606	1	0.85106	0.85106	0.85106	-	1	0.10638	0.10638	0.10638	-	1	0.04255	0.04255	0.04255	-
611	1	0.76923	0.76923	0.76923	-	1	0.15385	0.15385	0.15385	-	1	0.07692	0.07692	0.07692	-
616	1	0.44444	0.44444	0.44444	-	1	0.33333	0.33333	0.33333	-	1	0.22222	0.22222	0.22222	-
631	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
641	6	0.30769	0.96154	0.57528	0.26260	6	0.03846	0.66667	0.33614	0.26807	6	0.00000	0.45455	0.08858	0.18191
651	2	0.04762	0.15493	0.10127	0.07588	2	0.00000	0.00000	0.00000	0.00000	2	0.84507	0.95238	0.89873	0.07588
655	1	0.68571	0.68571	0.68571	-	1	0.17143	0.17143	0.17143	-	1	0.00000	0.00000	0.00000	-
679	1	0.75000	0.75000	0.75000	-	1	0.15000	0.15000	0.15000	-	1	0.00000	0.00000	0.00000	-
721	4	0.21053	0.98765	0.53566	0.36225	4	0.00000	0.33333	0.09722	0.15957	4	0.00000	0.78947	0.36712	0.41982

TABLE B-4 (Continued)

## COMPOSITION OF TOTAL CONTENT VALUE BY SIC

SIC	FRACTION OF TOTAL CONTENT VALUE IN INTERIOR EQUIPMENT					FRACTION OF TOTAL CONTENT VALUE IN BUSINESS RECORDS					FRACTION OF TOTAL CONTENT VALUE IN INVENTORY				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
722	3	0.30000	0.79167	0.53933	0.24609	3	0.00000	0.16667	0.08187	0.08337	3	0.04167	0.70000	0.37880	0.32946
723	9	0.33333	0.93750	0.74894	0.21332	9	0.00000	0.55556	0.10040	0.18261	9	0.06250	0.41667	0.15067	0.11177
724	1	0.65517	0.65517	0.65517	-	1	0.00000	0.00000	0.00000	-	1	0.34483	0.34483	0.34483	-
725	2	0.95890	0.98765	0.97328	0.02033	2	0.00000	0.00000	0.00000	0.00000	2	0.01235	0.04110	0.02672	0.02033
726	7	0.76923	1.00000	0.91291	0.10349	7	0.00000	0.00000	0.00000	0.00000	7	0.00000	0.18919	0.03581	0.06931
729	1	0.13514	0.13514	0.13514	-	1	0.54054	0.54054	0.54054	-	1	0.32432	0.32432	0.32432	-
733	1	0.46099	0.46099	0.46099	-	1	0.00709	0.00709	0.00709	-	1	0.53191	0.53191	0.53191	-
735	1	0.11765	0.11765	0.11765	-	1	0.05882	0.05882	0.05882	-	1	0.82353	0.82353	0.82353	-
736	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
737	1	0.20000	0.20000	0.20000	-	1	0.71429	0.71429	0.71429	-	1	0.08571	0.08571	0.08571	-
738	1	0.83333	0.83333	0.83333	-	1	0.03333	0.03333	0.03333	-	1	0.13333	0.13333	0.13333	-
751	2	0.29333	0.62500	0.45917	0.23452	2	0.06250	0.16667	0.11458	0.07366	2	0.00667	0.31250	0.15958	0.21626
753	17	0.13333	1.00000	0.68518	0.26212	17	0.00000	0.53125	0.08796	0.14695	17	0.00000	0.70000	0.15068	0.17947
754	1	0.95238	0.95238	0.95238	-	1	0.00000	0.00000	0.00000	-	1	0.04762	0.04762	0.04762	-
762	2	0.08333	0.21429	0.14881	0.09260	2	0.33333	0.71429	0.52381	0.26937	2	0.07143	0.58333	0.32738	0.36197
769	1	0.45455	0.45455	0.45455	-	1	0.22727	0.22727	0.22727	-	1	0.31818	0.31818	0.31818	-
791	1	0.95506	0.95506	0.95506	-	1	0.02809	0.02809	0.02809	-	1	0.01685	0.01685	0.01685	-
792	1	0.85714	0.85714	0.85714	-	1	0.14286	0.14286	0.14286	-	1	0.00000	0.00000	0.00000	-
793	1	0.95847	0.95847	0.95847	-	1	0.00160	0.00160	0.00160	-	1	0.03994	0.03994	0.03994	-
799	6	0.01961	1.00000	0.59595	0.43627	6	0.00000	0.54545	0.09224	0.22205	6	0.00000	0.98039	0.23616	0.37796
801	8	0.04420	0.96447	0.67901	0.31680	8	0.00000	0.50000	0.14871	0.18699	8	0.00000	0.11111	0.05281	0.04267
802	1	0.64516	0.64516	0.64516	-	1	0.29032	0.29032	0.29032	-	1	0.06452	0.06452	0.06452	-
804	1	0.49505	0.49505	0.49505	-	1	0.49505	0.49505	0.49505	-	1	0.00990	0.00990	0.00990	-

TABLE B-4 (Continued)

## COMPOSITION OF TOTAL CONTENT VALUE BY SIC

SIC	FRACTION OF TOTAL CONTENT VALUE IN INTERIOR EQUIPMENT					FRACTION OF TOTAL CONTENT VALUE IN BUSINESS RECORDS					FRACTION OF TOTAL CONTENT VALUE IN INVENTORY				
	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
805	1	0.81081	0.81081	0.81081	-	1	0.05405	0.05405	0.05405	-	1	0.13514	0.13514	0.13514	-
806	1	0.95455	0.95455	0.95455	-	1	0.00000	0.00000	0.00000	-	1	0.04545	0.04545	0.04545	-
807	1	0.73171	0.73171	0.73171	-	1	0.02439	0.02439	0.02439	-	1	0.24390	0.24390	0.24390	-
809	3	0.22222	1.00000	0.54402	0.40588	3	0.00000	0.55556	0.34912	0.30402	3	0.00000	0.22222	0.10686	0.11135
811	1	0.76923	0.76923	0.76923	-	1	0.23077	0.23077	0.23077	-	1	0.00000	0.00000	0.00000	-
821	9	0.19920	0.98039	0.76044	0.31154	9	0.00398	0.74074	0.14300	0.23838	9	0.00000	0.79681	0.09656	0.26282
823	2	0.01474	0.98305	0.49890	0.68470	2	0.00246	0.01695	0.00970	0.01025	2	0.00000	0.98280	0.49140	0.69495
832	1	0.59524	0.59524	0.59524	-	1	0.29762	0.29762	0.29762	-	1	0.10714	0.10714	0.10714	-
835	2	0.84211	0.90909	0.87560	0.04737	2	0.04545	0.10526	0.07536	0.04229	2	0.04545	0.05263	0.04904	0.00507
841	1	0.04000	0.04000	0.04000	-	1	0.00500	0.00500	0.00500	-	1	0.60000	0.60000	0.60000	-
863	1	0.45455	0.45455	0.45455	-	1	0.51515	0.51515	0.51515	-	1	0.03030	0.03030	0.03030	-
864	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
866	16	0.26282	1.00000	0.80534	0.20819	16	0.00000	0.39526	0.09181	0.12942	16	0.00000	0.44872	0.08570	0.13394
869	1	0.27778	0.27778	0.27778	-	1	0.35185	0.35185	0.35185	-	1	0.37037	0.37037	0.37037	-
871	4	0.28409	0.72727	0.55126	0.21049	4	0.18182	0.56818	0.37916	0.17716	4	0.00356	0.14773	0.06958	0.06335
872	2	0.06250	0.47368	0.26809	0.29075	2	0.52632	0.78125	0.65378	0.18027	2	0.00000	0.15625	0.07813	0.11049
899	1	0.05650	0.05650	0.05650	-	1	0.00188	0.00188	0.00188	-	1	0.94162	0.94162	0.94162	-
911	2	0.34098	0.55676	0.44887	0.15258	2	0.02770	0.65574	0.34172	0.44409	2	0.00328	0.41554	0.20941	0.29151
922	4	0.52586	1.00000	0.78893	0.19889	4	0.00000	0.43103	0.16458	0.20745	4	0.00000	0.14286	0.04649	0.06738
951	1	0.17857	0.17857	0.17857	-	1	0.71429	0.71429	0.71429	-	1	0.10714	0.10714	0.10714	-
953	1	0.94937	0.94937	0.94937	-	1	0.03165	0.03165	0.03165	-	1	0.01899	0.01899	0.01899	-



**APPENDIX C**

**ANALYSIS OF VARIANCE OUTPUT  
FOR CONTENT VALUATION FUNCTIONS**

## DATA DICTIONARY

LNCONT	Natural logarithm of content value
LNSQFT2	Natural logarithm of building area in square feet
LNNOEMP	Natural logarithm of number of employees
LNREPVAL	Natural logarithm of depreciated structure replacement value
MANUFACT	Categorical variable indicating membership in the manufacturing sector (1 = yes/0 = no)
SERVICE	Categorical variable indicating membership in the service sector (1 = yes/0 = no)
SIC (nn)	Categorical variable indicating business SIC (1 = member/0 = nonmember)
CONTENT	Building content value
SQFT2	Building area in square feet
NOEMPLO	Number of employees
FLOODED	Categorical variable indicating building was flooded by Tropical Storm Agnes (1 = yes/0 = no)
YEARS	Number of years in business at location
LYEARS	Natural logarithm of years in business at location



Model: MODEL1: Alternative A  
 Dependent Variable: LNCONT

# ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	6	634.22145	105.70358	93.344	0.0001
Error	364	412.19488	1.13240		
C Total	370	1046.41633			
Root MSE	1.06414		R-square	0.6061	
Dep Mean	12.11442		Adj R-sq	0.5996	
C.V.	8.78412				

# PARAMETER ESTIMATES

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	3.563954	0.64568303	5.520	0.0001
INSQFT2	1	0.220248	0.08310216	2.650	0.0084
LNNOEMP	1	0.300097	0.05560497	5.397	0.0001
LNRVAL	1	0.494298	0.08826325	5.600	0.0001
MAN	1	0.793954	0.21777550	3.646	0.0003
SER	1	-0.258246	0.12588101	-2.052	0.0409
FIN	1	-0.494078	0.28951048	-1.707	0.0887

Model: MODEL2: Alternative B  
Dependent Variable: LNCONT

### ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	8	654.86718	81.85840	75.681	0.0001
Error	362	391.54915	1.08163		
C Total	370	1046.41633			
Root MSE	1.04001		R-square	0.6258	
Dep Mean	12.11442		Adj R-sq	0.6175	
C.V.	8.58492				

### PARAMETER ESTIMATES

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	3.617712	0.64420796	5.616	0.0001
LNSQFT2	1	0.301114	0.07819391	3.851	0.0001
LNNOEMP	1	0.353923	0.05549629	6.377	0.0001
LNRVAL	1	0.432053	0.08529407	5.065	0.0001
SIC56	1	0.638824	0.28662864	2.229	0.0264
SIC58	1	-0.834098	0.19546615	-4.267	0.0001
SIC79	1	-1.073971	0.35223889	-3.049	0.0025
SIC82	1	-0.949863	0.35280403	-2.692	0.0074
SIC86	1	-0.593286	0.27270192	-2.176	0.0302

Model: MODEL3: Alternative C  
 Dependent Variable: LNCONT

### ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	3	608.64217	202.88072	170.081	0.0001
Error	367	437.77416	1.19285		
C Total	3701	046.41633			
Root MSE	1.09217		R-square	0.5816	
Dep Mean	12.11442		Adj R-sq	0.5782	
C.V.	9.01549				

### PARAMETER ESTIMATES

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	3.991466	0.65184794	6.123	0.0001
LNSQFT2	1	0.353897	0.08021717	4.412	0.0001
LNNOEMP	1	0.356972	0.05563434	6.416	0.0001
LNRVAL	1	0.353529	0.08516722	4.151	0.0001

Model: MODEL4: Simple Linear Specification  
 Dependent Variable: CONTENT

#### ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	6.9633302E14	1.7408325E14	6.920	0.0001
Error	342	8.6029808E15	2.5154915E13		
C Total	346	9.2993138E15			
Root MSE	5015467.53773		R-square	0.0749	
Dep Mean	1072158.72334		Adj R-sq	0.0641	
C.V.	467.79152				

#### PARAMETER ESTIMATES

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	128896	528802.60670	0.244	0.8076
SQFT2	1	30.848221	.71697163	3.539	0.0005
NOEMPLO	1	10939	4278.7494297	2.557	0.0110
YEARS	1	-11012	10316.736993	-1.067	0.2866
FLOODED	1	691381	627051.76241	1.103	0.2710

Model: MODEL5: Linear Log specification  
 Dependent Variable: CONTENT

### ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	7.9456377E14	1.9864094E14	7.988	0.0001
Error	342	8.50475E15	2.486769E13		
C Total	346	9.2993138E15			
Root MSE	4986751.46771	R-square	0.0854		
Dep Mean	1072158.72334	Adj R-sq	0.0747		
C.V.	465.11317				

### PARAMETER ESTIMATES

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	-4971157	1991215.1422	-2.497	0.0130
LNSQFT2	1	546282	260088.33573	2.100	0.0364
LNNOEMP	1	663684	244460.37512	2.715	0.0070
LNYEARS	1	-174280	253781.34075	-0.687	0.4927
FLOODED	1	605203	645092.72860	0.938	0.3488

Model: MODEL6: Log Linear Specification  
 Dependent Variable: LNCONT

### ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	316.09740	79.02435	40.408	0.0001
Error	342	668.83376	1.95565		
C Total	346	984.93116			
Root MSE		1.39845	R-square	0.3209	
Dep Mean		12.15252	Adj R-sq	0.3130	
C.V.		11.50747			

### PARAMETER ESTIMATES

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	11.511098	0.14744437	78.071	0.0001
SQFT2	1	0.000021640	0.00000243	8.903	0.0001
NOEMPLO	1	0.007186	0.00119303	6.023	0.0001
YEARS	1	-0.005082	0.00287658	-1.767	0.0782
FLOODED	1	0.369737	0.17483888	2.115	0.0352

Model: MODEL7: Log Log Specification  
 Dependent Variable: LNCONT

### ANALYSIS OF VARIANCE

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	570.11978	142.52994	117.512	0.0001
Error	342	414.81138	1.21290		
C Total	346	984.93116			
Root MSE		1.10132	R-square	0.5788	
Dep Mean		12.15252	Adj R-sq	0.5739	
C.V.		9.06246			

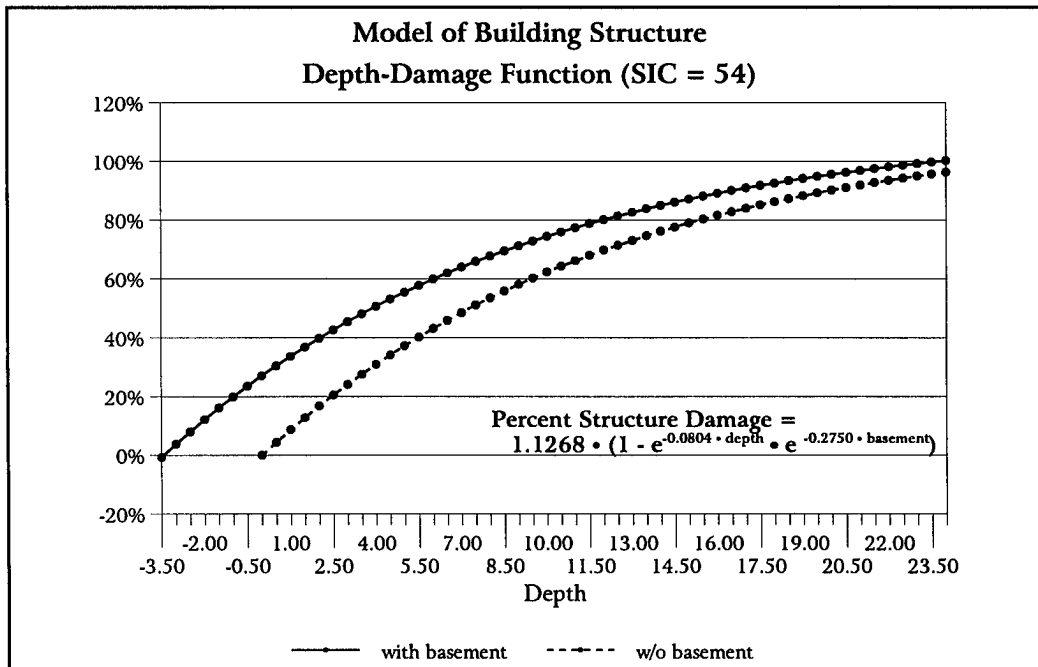
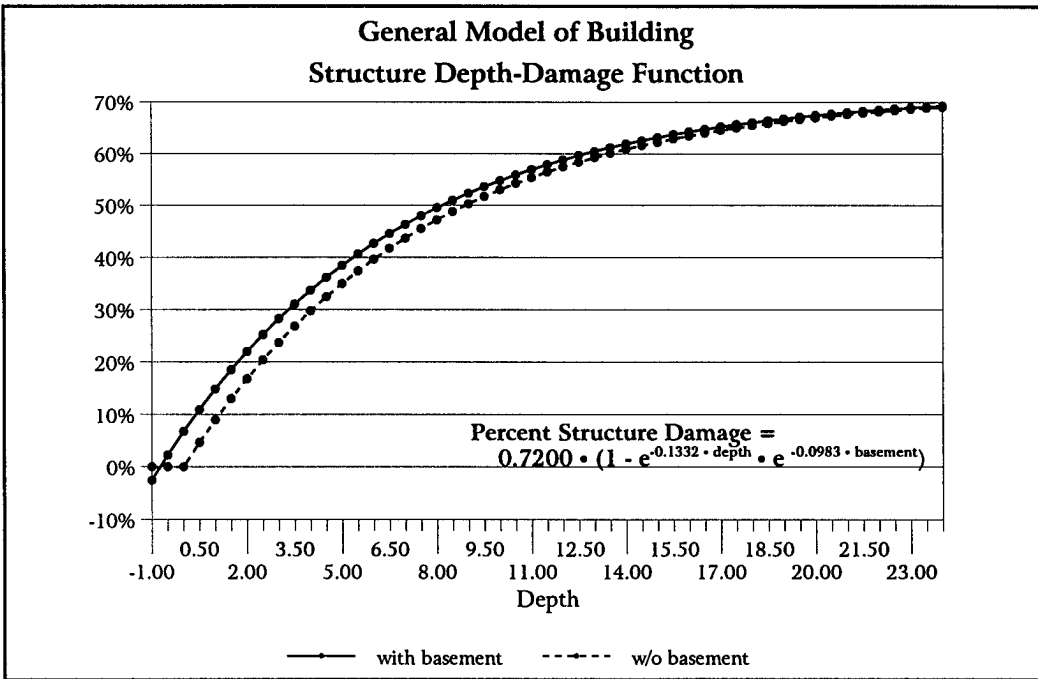
### PARAMETER ESTIMATES

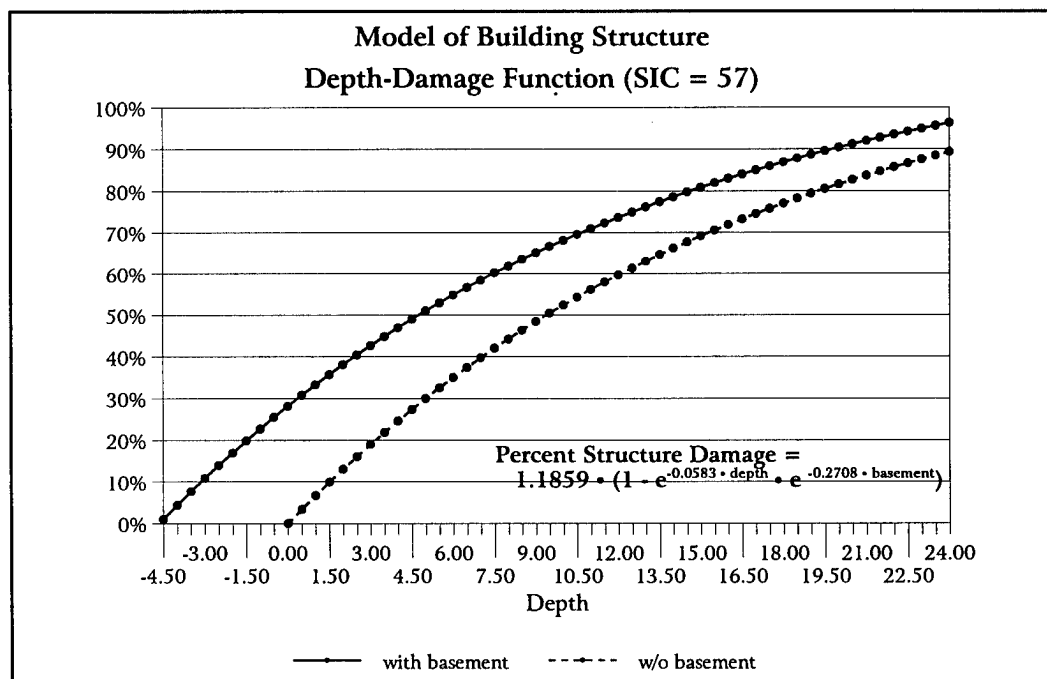
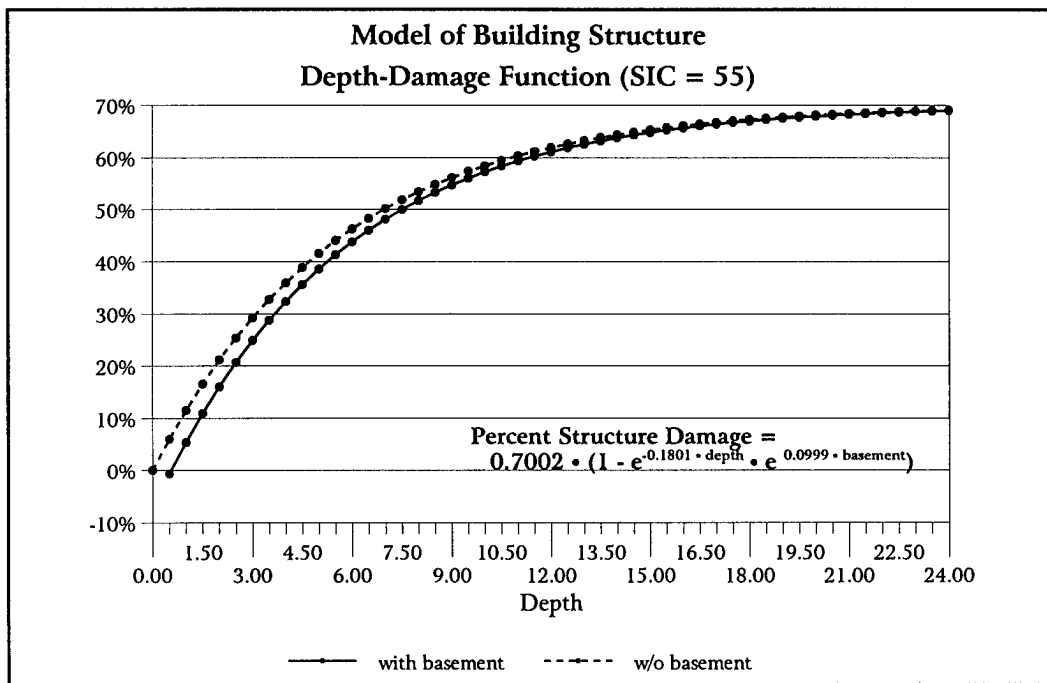
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >  T
INTERCEP	1	6.051282	0.43975698	13.761	0.0001
LNSQFT2	1	0.608892	0.05744013	10.600	0.0001
LNNOEMP	1	0.434959	0.05398872	8.056	0.0001
LNYEARS	1	-0.090220	0.05604724	-1.610	0.1084
FLOODED	1	0.237885	0.14246779	1.670	0.0959

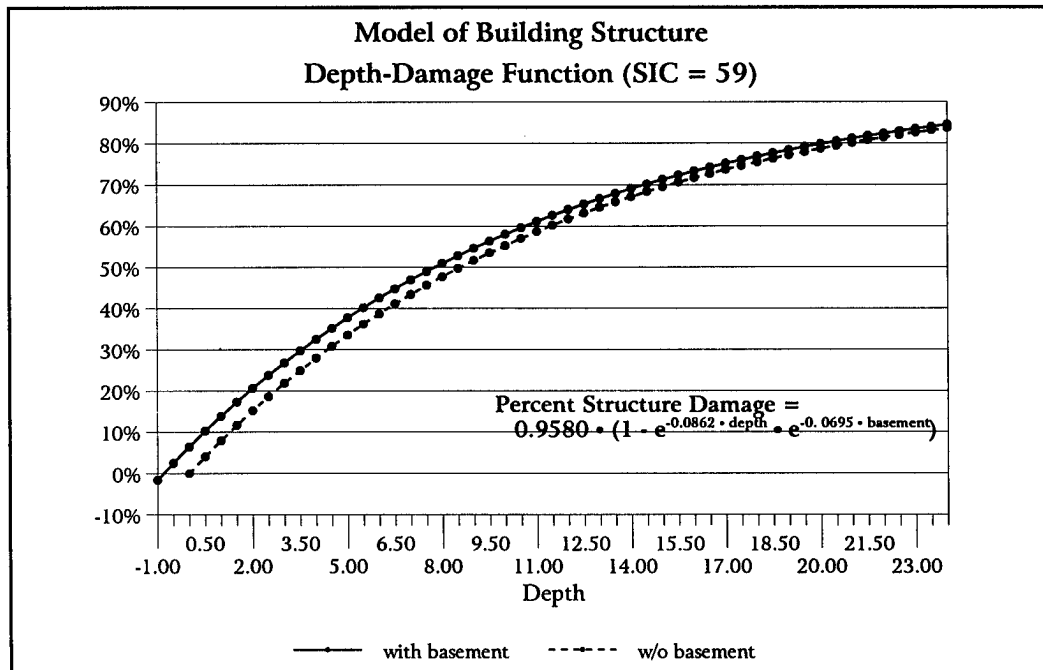
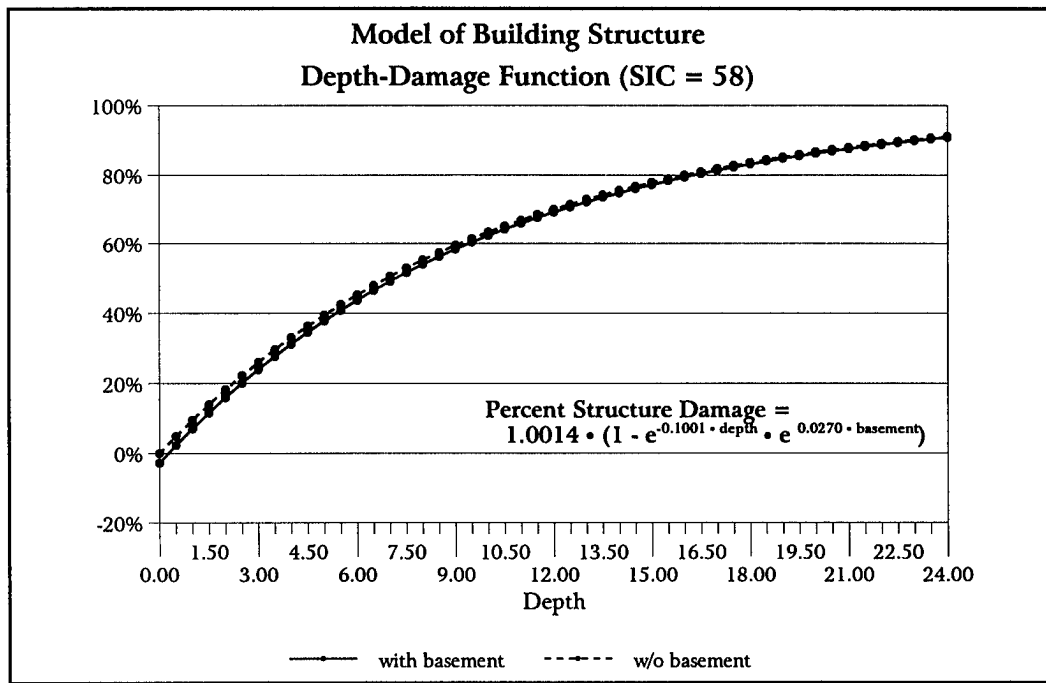


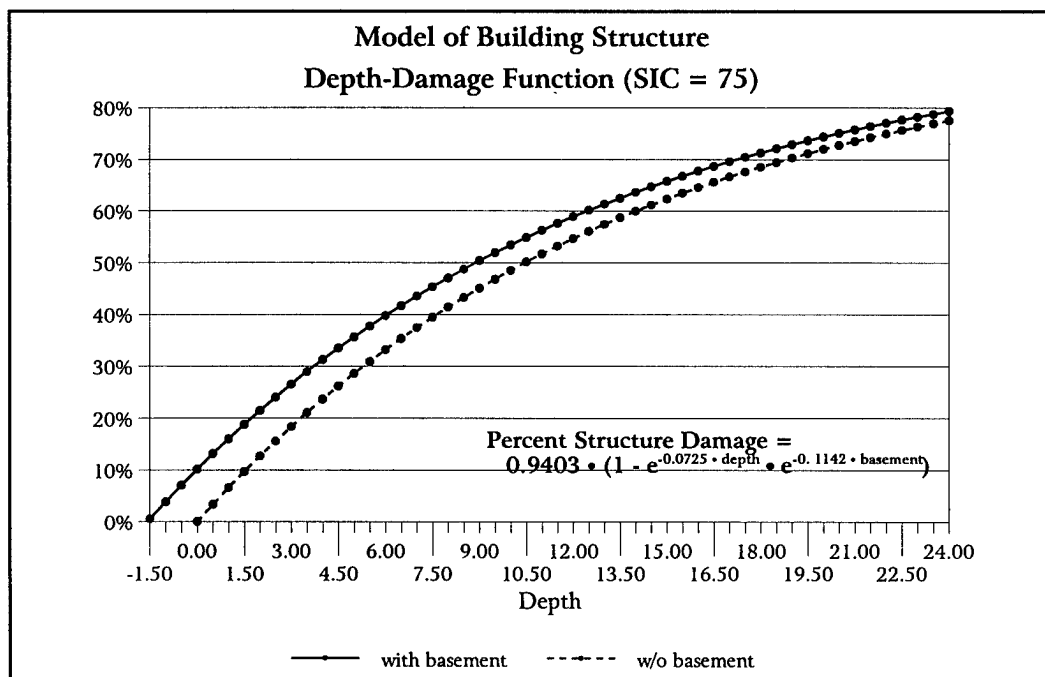
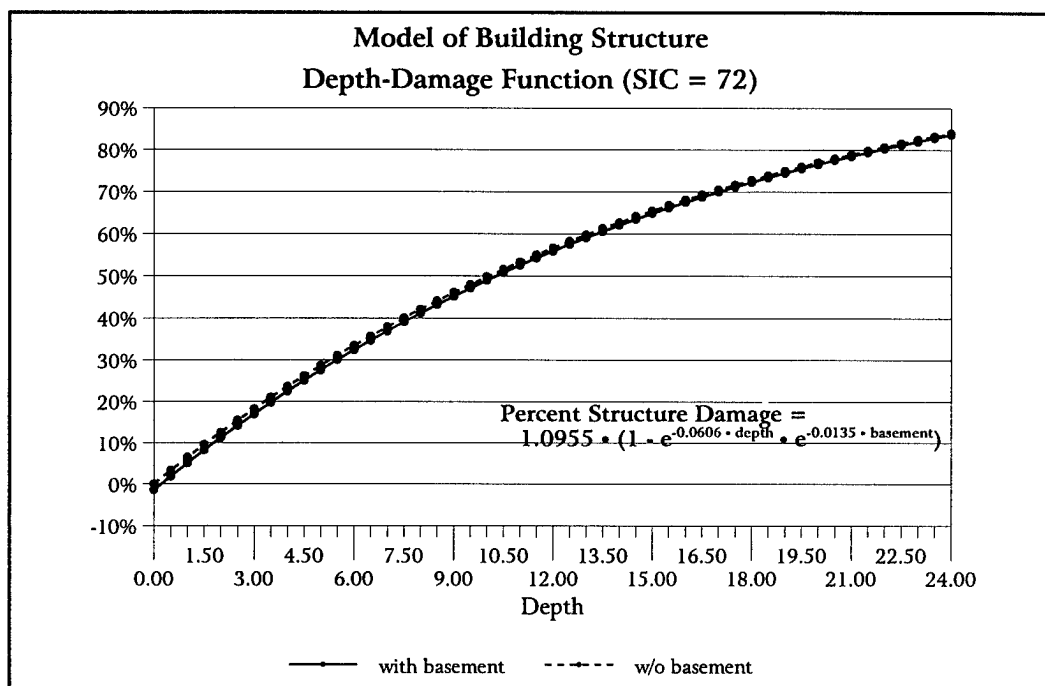
**APPENDIX D**

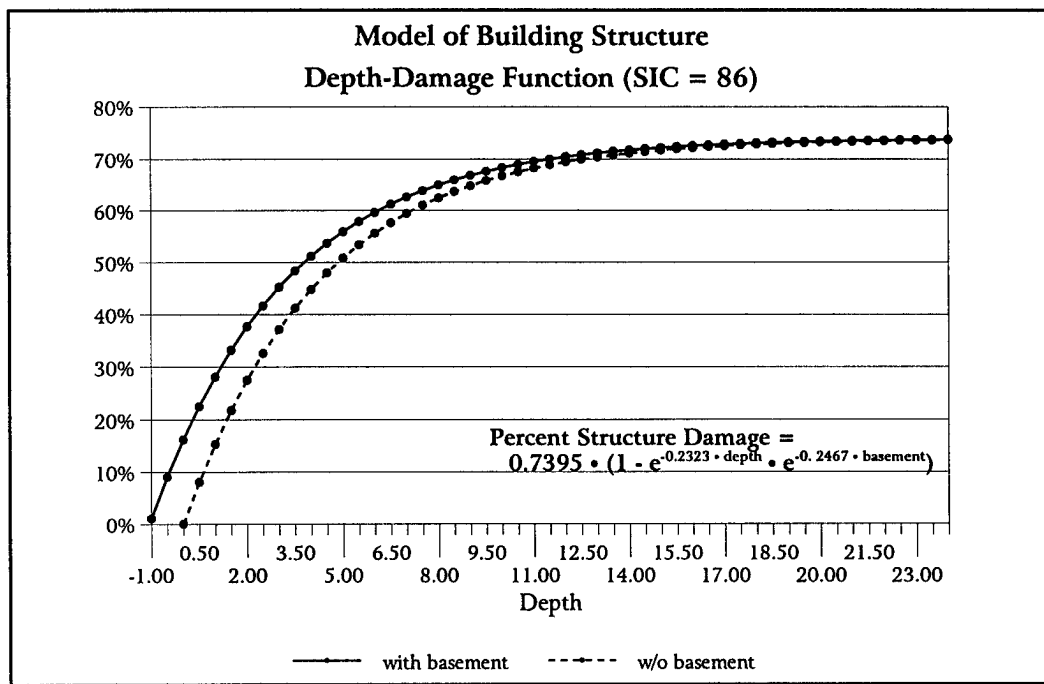
**STRUCTURE DEPTH-DAMAGE FUNCTIONS**







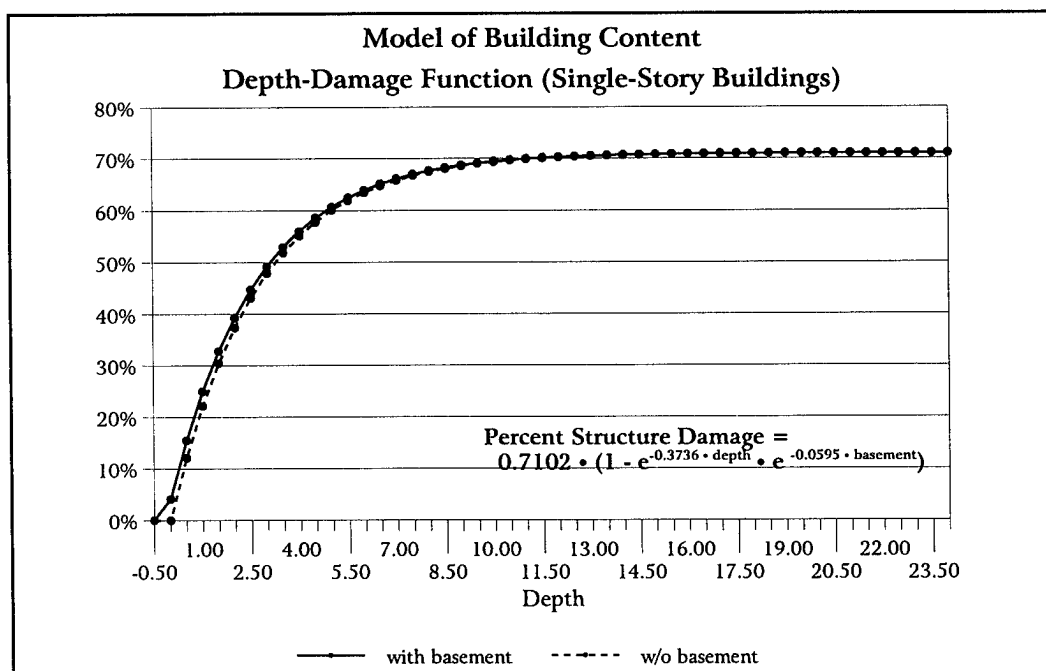
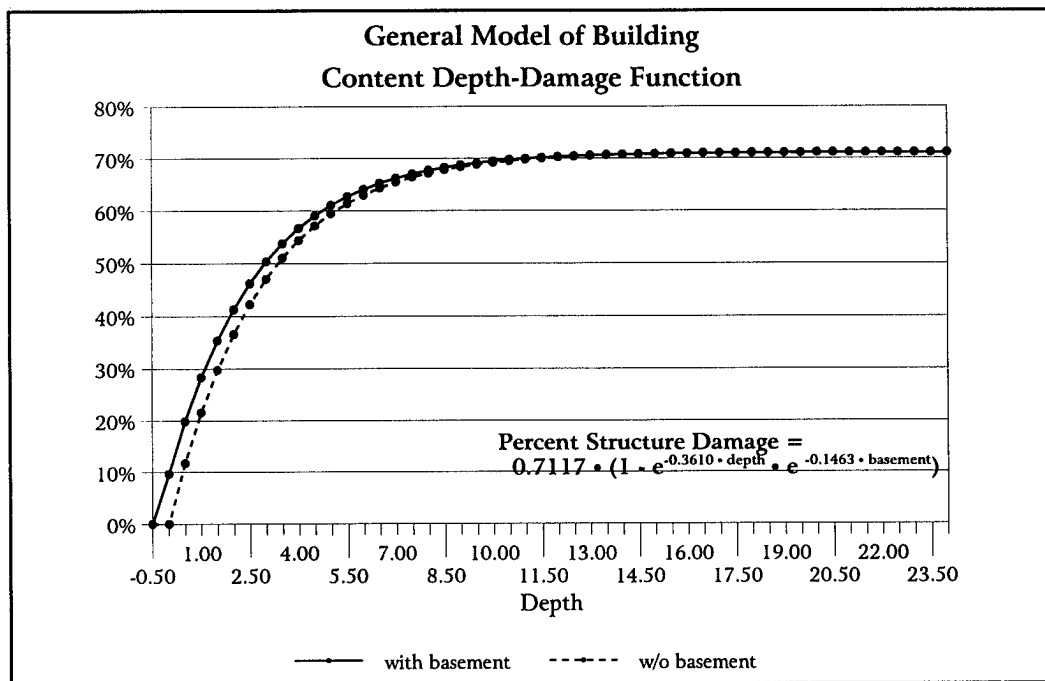


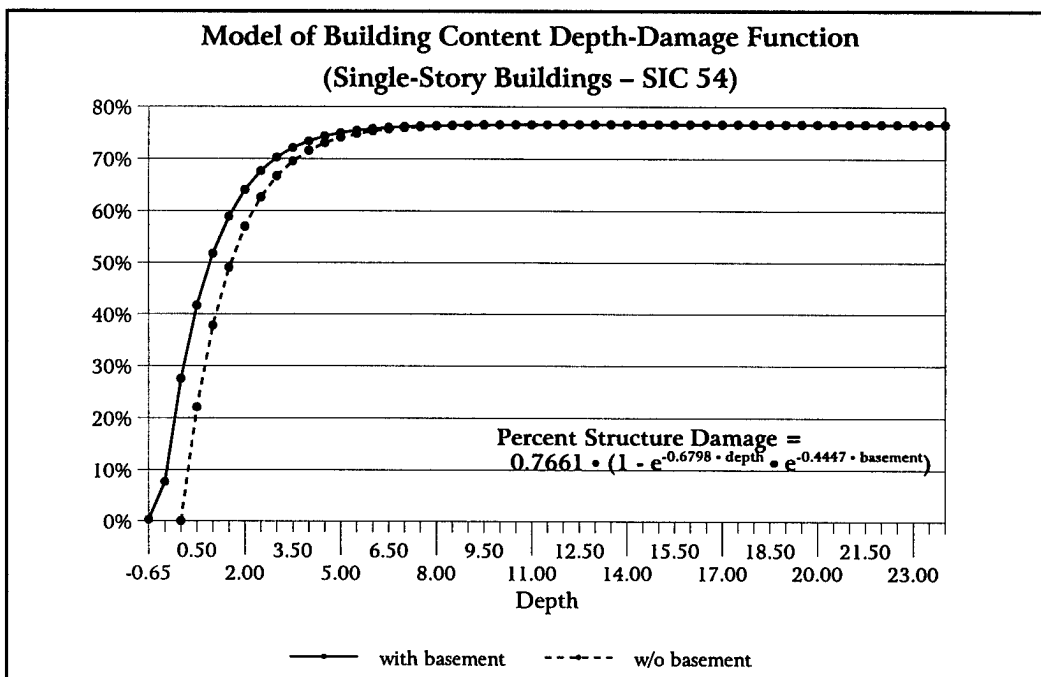
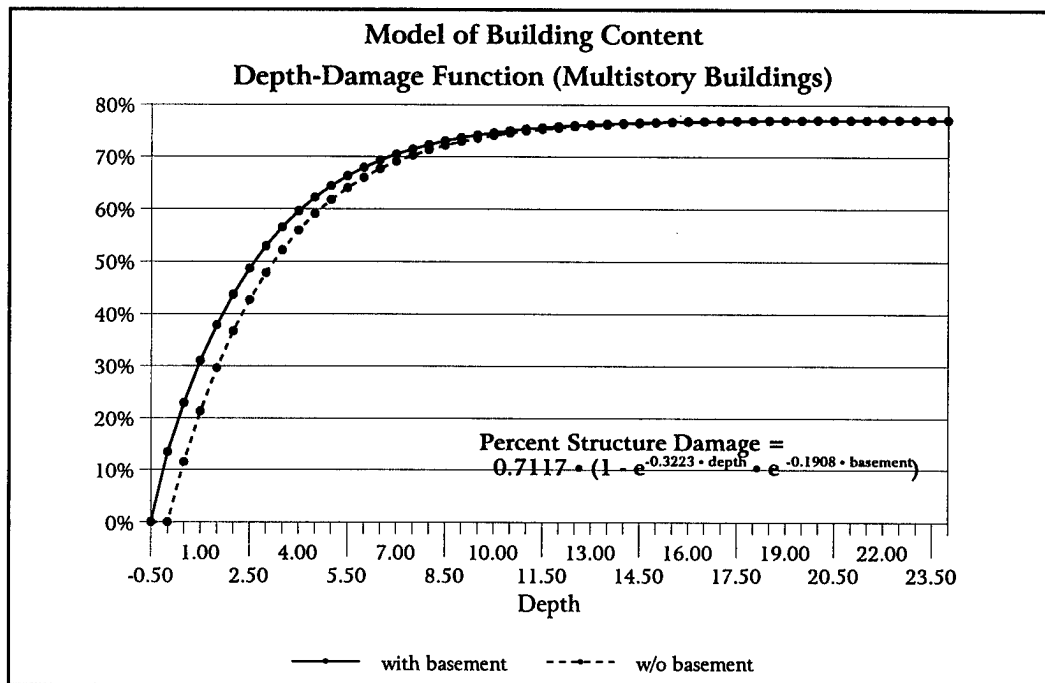


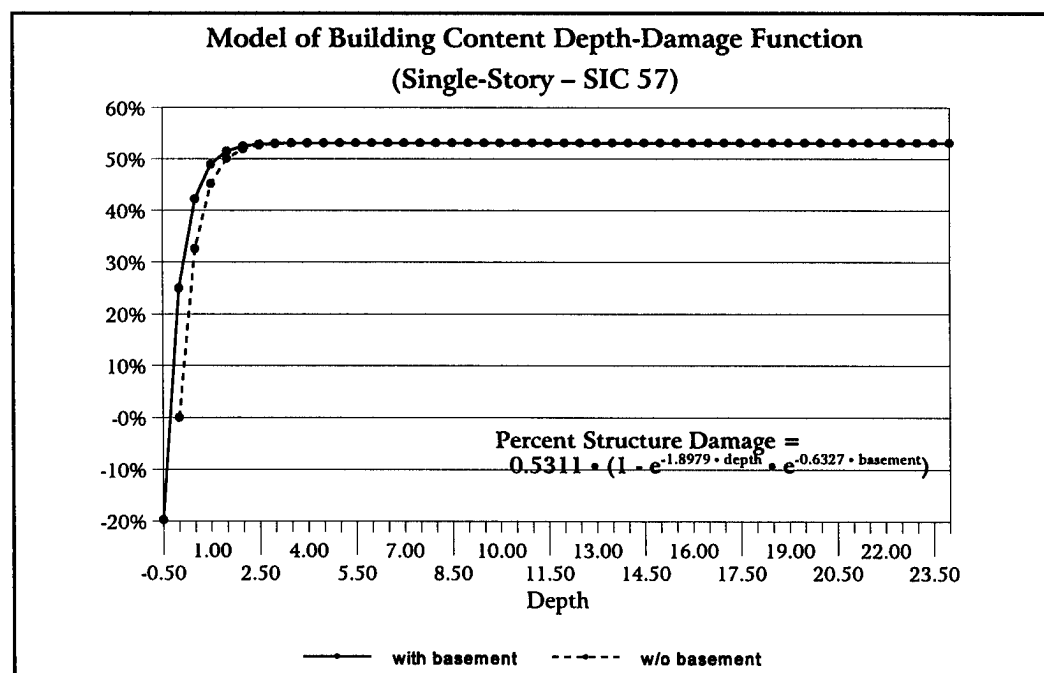
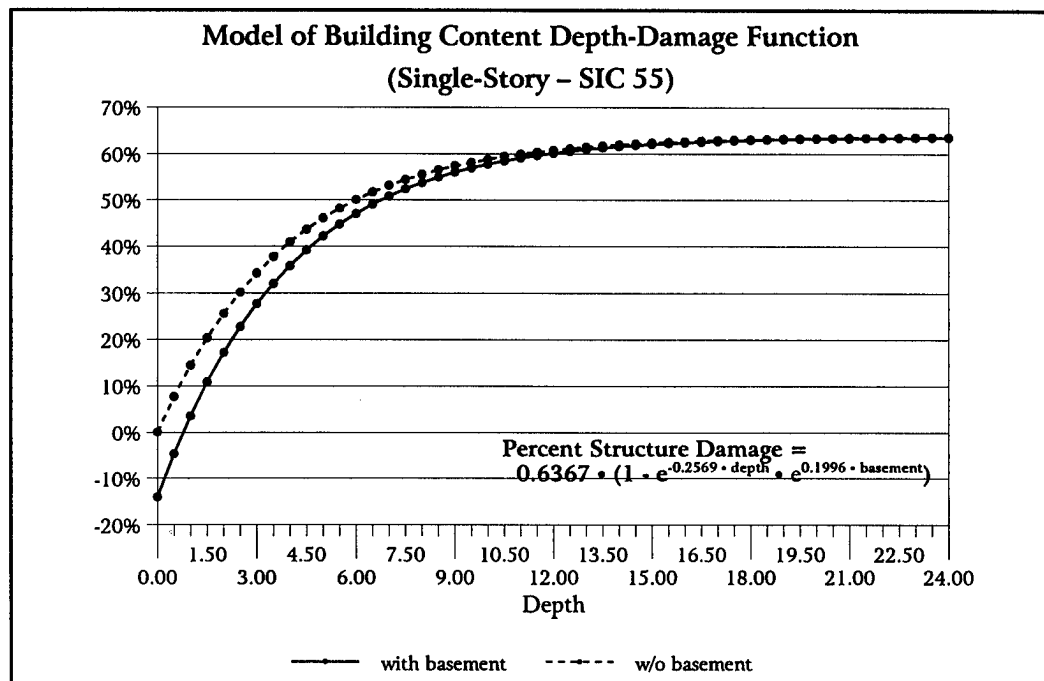


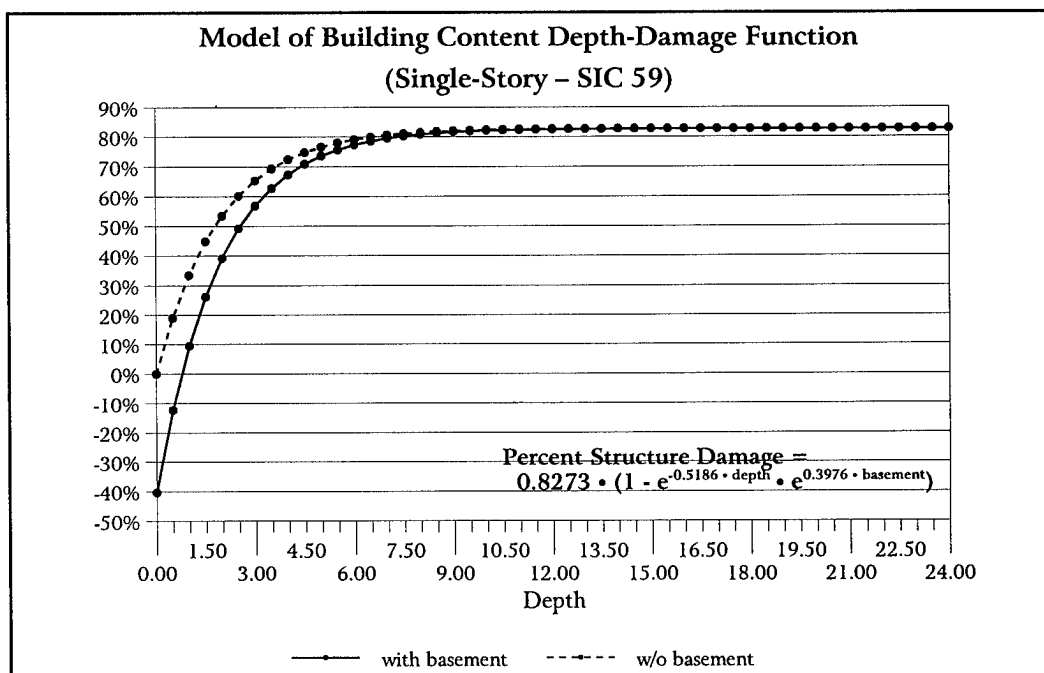
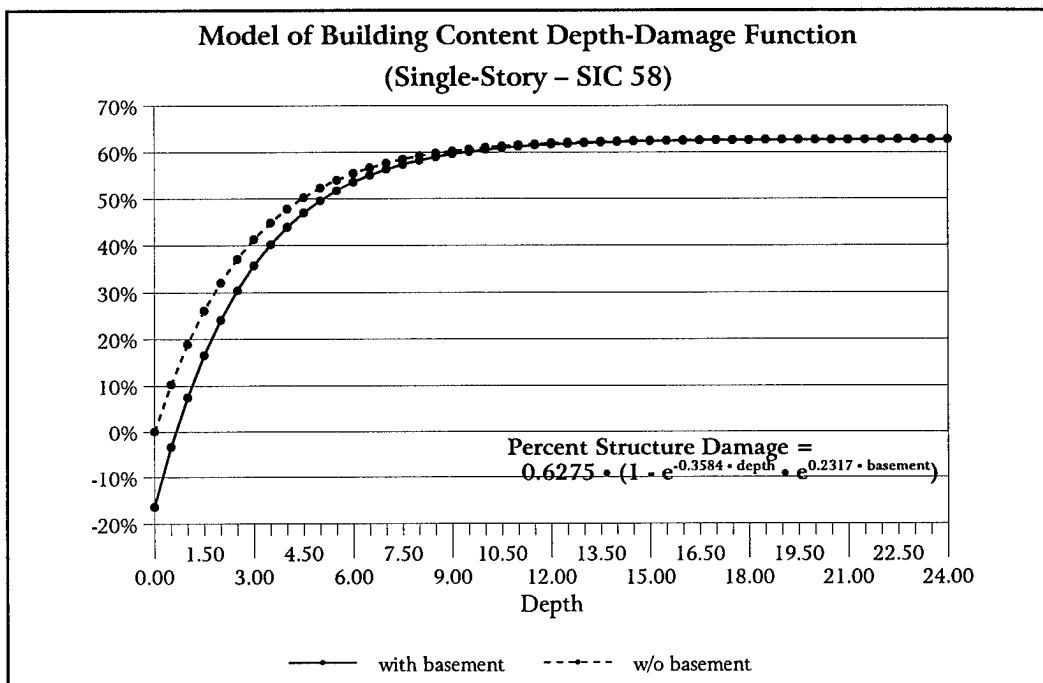
**APPENDIX E**

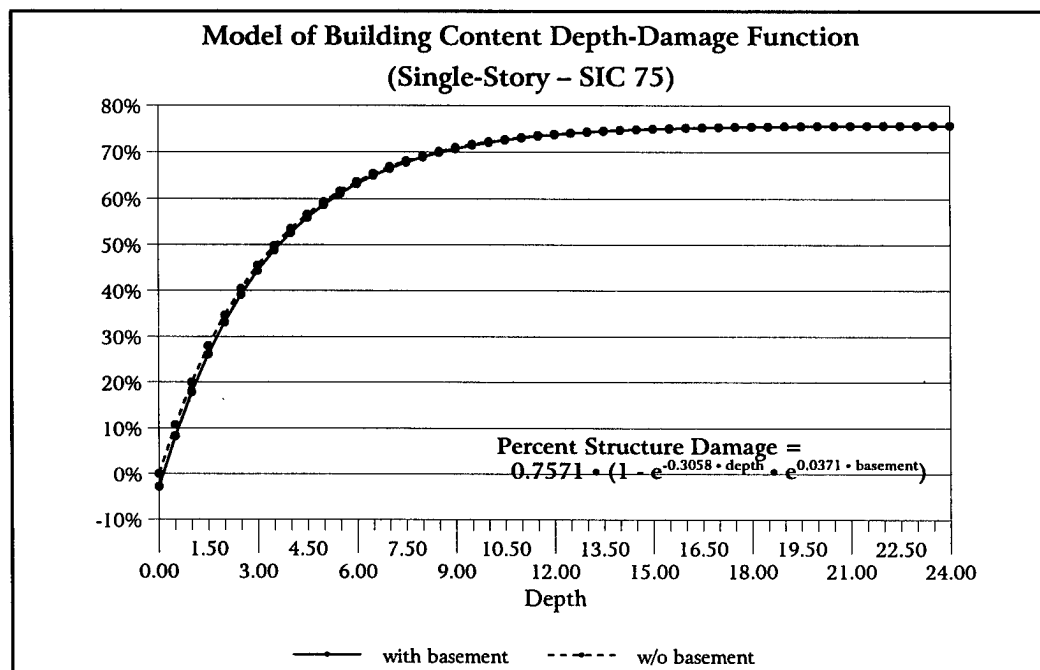
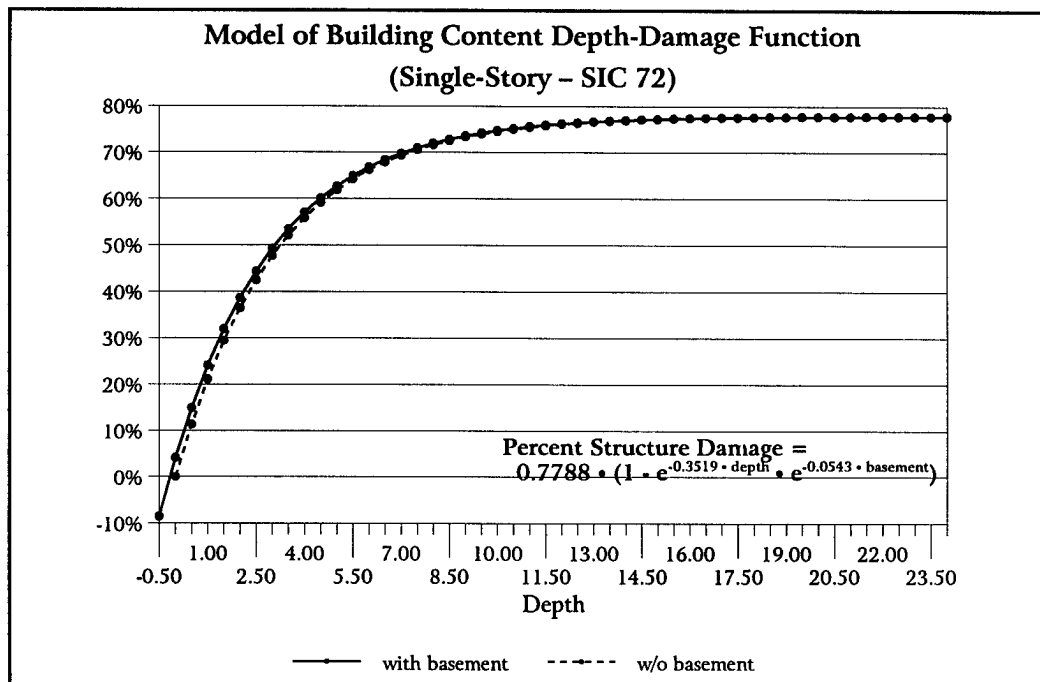
**CONTENT DEPTH-DAMAGE FUNCTIONS**

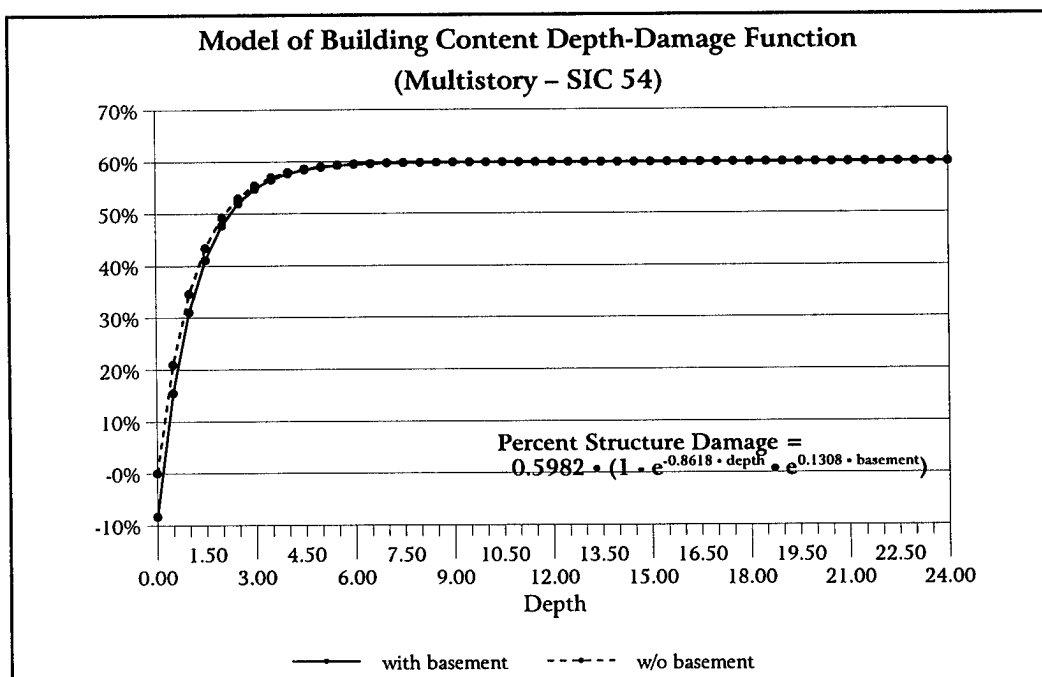
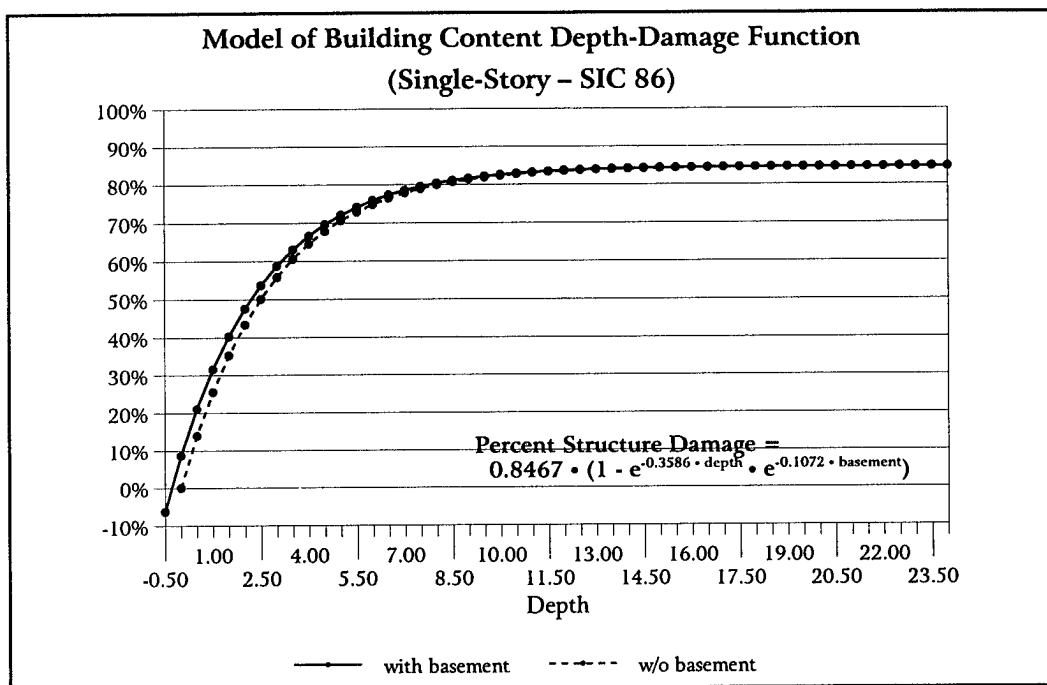


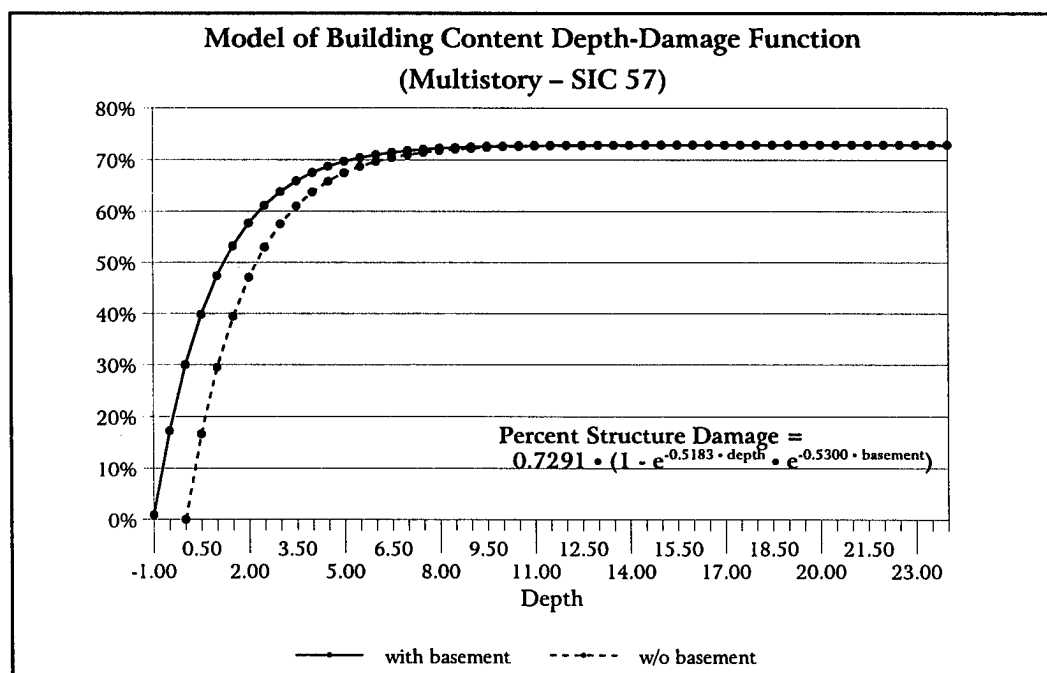
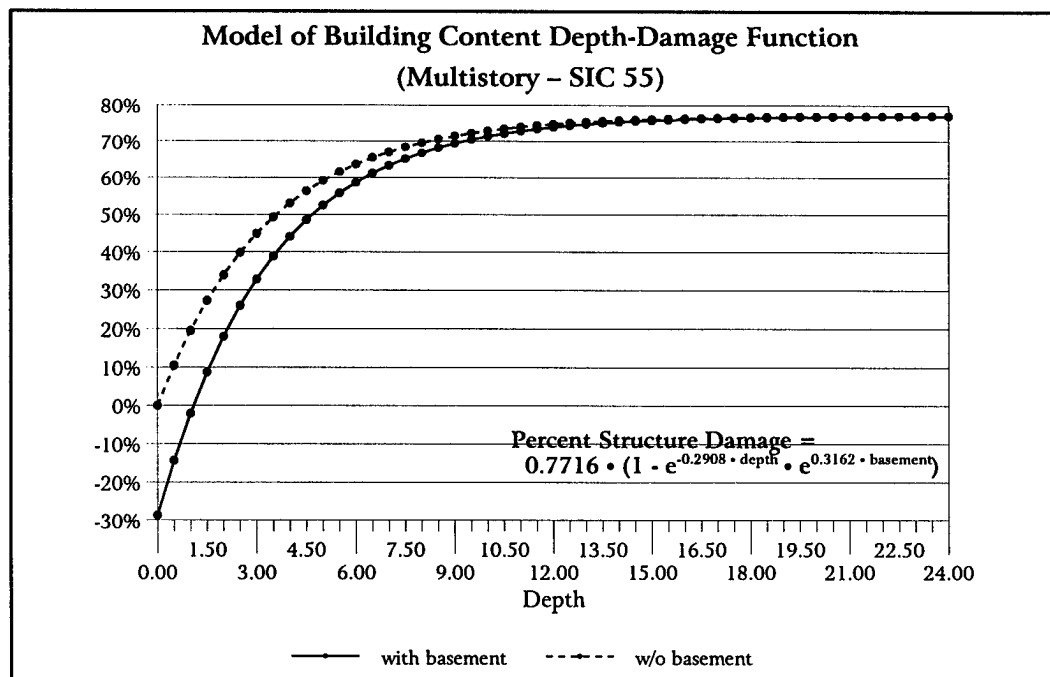


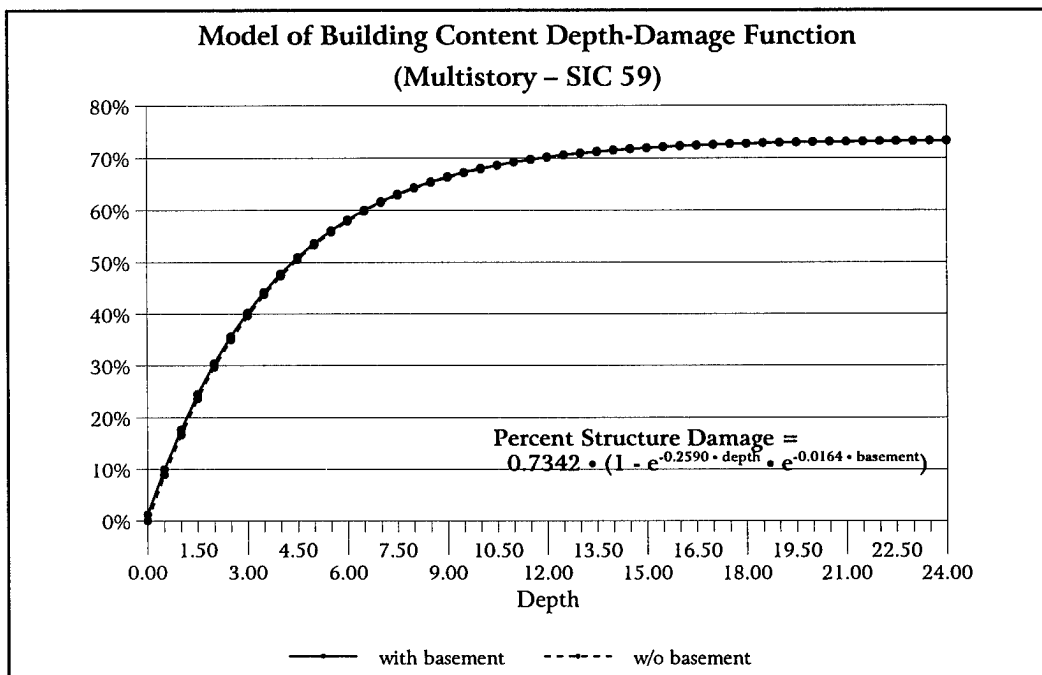
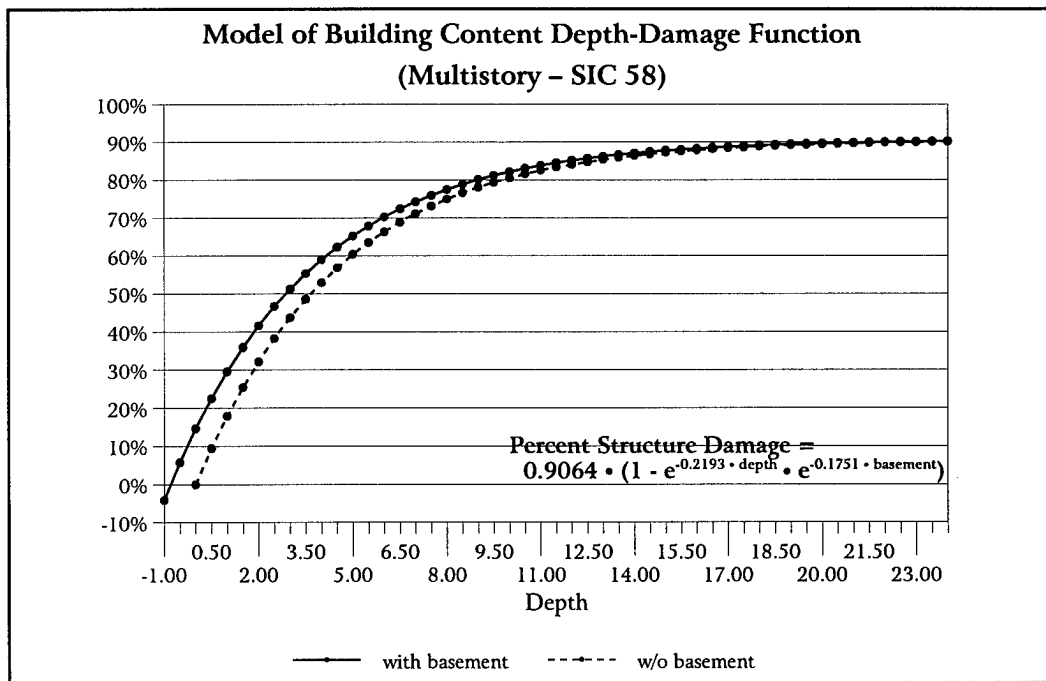


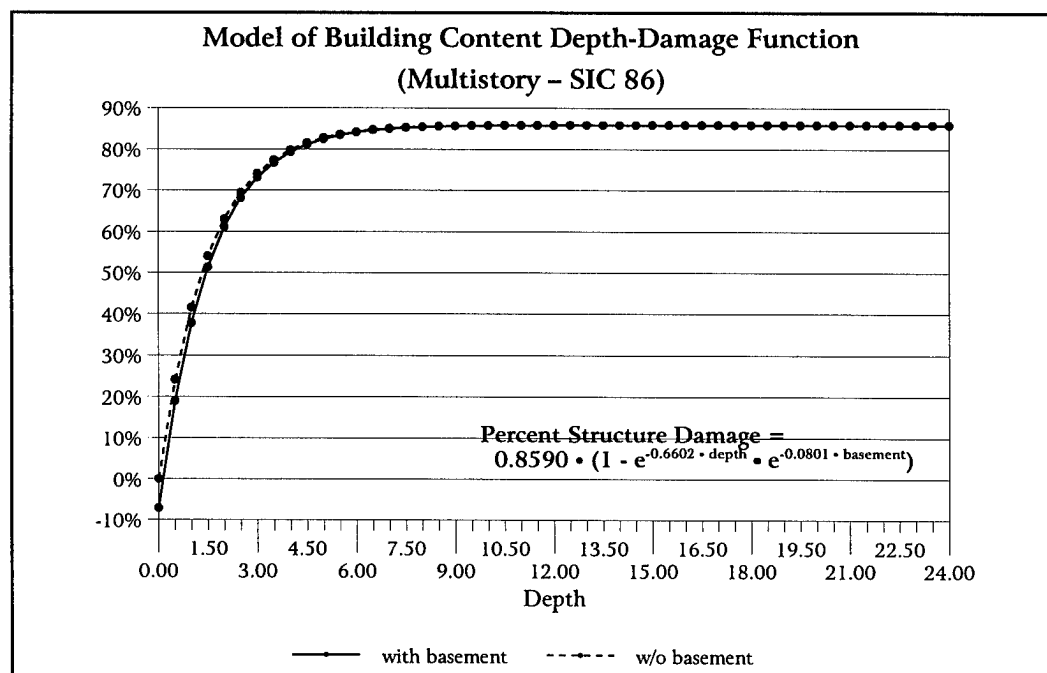
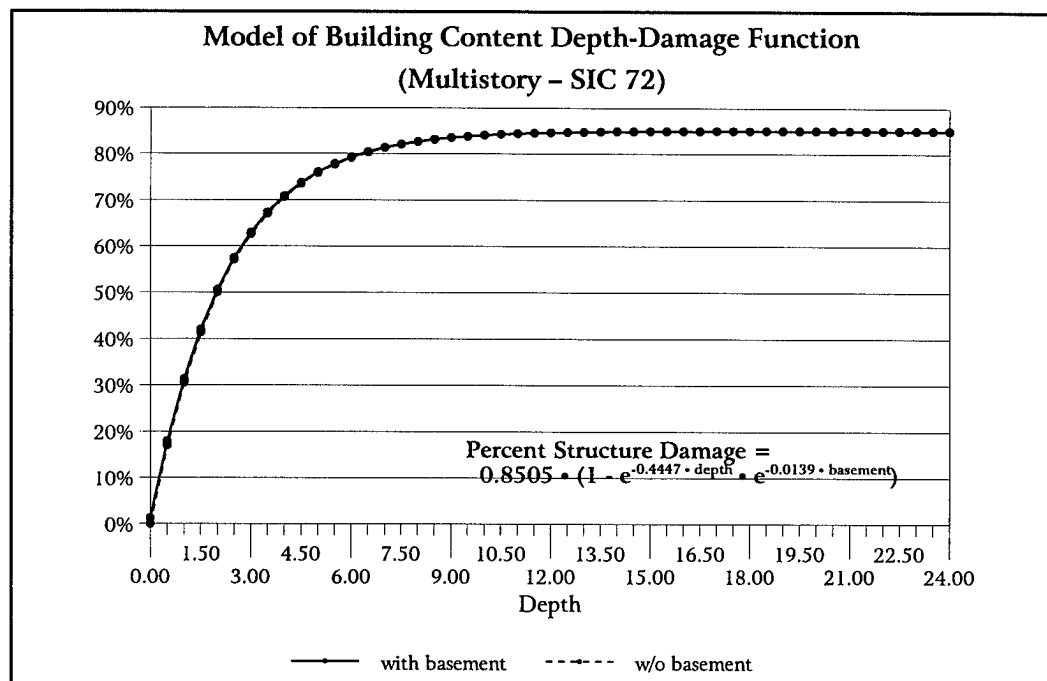












# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE May 1996	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE Analysis of Nonresidential Content Value and Depth-Damage Data for Flood Damage Reduction Studies			5. FUNDING NUMBERS	
6. AUTHOR(S) Jack C. Kiefer and J. Scott Willett Planning and Management Consultants, Ltd.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers Water Resources Support Center Institute for Water Resources Casey Building 7701 Telegraph Road Alexandria, VA 22315-3868			8. PERFORMING ORGANIZATION REPORT NUMBER IWR Report 96-R-12	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers, Headquarters Civil Works - Planning Division Pulaski Building 20 Massachusetts Avenue, N.W. Washington, DC 20314-1000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Available from National Technical Information Service 5285 Port Royal Road, Springfield, VA 22161 Phone: (703) 487-4650, FAX: (703) 321-8547				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This study reports how data collected by the Baltimore District, Corps of Engineers of businesses in the Wyoming Valley in Northeastern Pennsylvania was used to create models for estimating business content value and depth-damage relationships. The survey included such questions as the type of business operation, number of employees, years at that location, previous flood experience, value of contents and outside property, previous flood damage, and expected flood damage for various hypothetical flood levels, and building characteristics. This study produced content-to-structure value ratios for the entire sample and for 3-digit SIC groups, content valuation functions that predict the value of inside contents based on readily available information on square footage, number of employees, and depreciated structure replacement value, structure depth-damage functions that predict damages to buildings over a range of flood depths, and content depth-damage functions that predict damages to the contents of buildings over a range of flood depths. The report also describes the value of various secondary sources that were considered to have potential for estimating business content value.				
14. SUBJECT TERMS Business Content Value, Flood Damage, Cost-Benefit Analysis, Replacement Value, Depreciation.			15. NUMBER OF PAGES 119	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED	